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ABSTRACT

Advances in information technology (IT) are reshaping the U.S. labor market. The demand for workers who can read and understand complex material, think analytically, and use technology efficiently will continue to increase. Congress established the 21st Century Workforce Commission to assess current and future demand for IT workers and the education and training needed to fill IT jobs. By conducting field hearings and site visits and reviewing pertinent research, the commission identified nine keys to success that leaders at all levels can apply to build a highly skilled workforce prepared for high-technology job opportunities in the 21st century. The keys are as follows: (1) building 21st century literacy; (2) exercising leadership through partnerships; (3) forming learning linkages for youth; (4) identifying pathways to IT jobs; (5) increasing acquisition of IT skills; (6) expanding continuous learning; (7) shaping a flexible immigration policy for skilled IT workers; (8) raising student achievement; (9) and making technology access and Internet connectivity universal. During its work, the commission found many examples of how stakeholders at all levels exerted the leadership to put the keys into practice. (Ten tables/figures are included. Concluding the report are a list of the commission members and 85 endnotes.) (MN)

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A Nation of Opportunity

BUILDING AMERICA'S 21st CENTURY WORKFORCE

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A Report Prepared by the

21st Century Workforce Commission

CE 080 388

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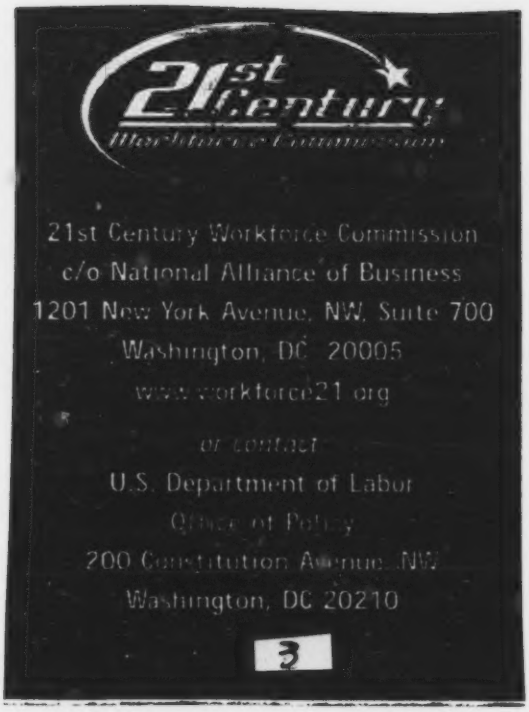

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A Note to Today's Working American

Dear friend,

This report echoes the message that every American worker needs to acquire higher levels of education and training to succeed in today's and tomorrow's economy.

As the digital revolution unfolds, we realize that job security cannot be dependent upon a corporate identity. Job security rests on the skills and knowledge you carry with you — your "employability."

That is why we hope you see it in your best interest to take an active management role over your own skills and education.

Of course, you will need to make sure you have the solid reading, math, learning, and thinking skills demanded by 21st Century Literacy. You may also find it necessary to upgrade specific technical skills based on your personal likes, aptitudes, and job market opportunities.

You can tap into a wide variety of resources to develop your skills. Community colleges, local One-Stop Career Centers, and community-based centers can help you access career planning tools, as well as the basic skills, technology skills, and other educational courses you will need.

As you begin this process of education and training, remember that acquiring new job skills is not a once-in-a-career event. As technology continues to change and evolve, every one of us needs to make learning a lifetime habit.

Rapid technological change has made today's world very demanding. Yet, these changes also offer us enormous opportunities for personal growth, fulfillment, and success — the ideal of America as the "Nation of Opportunity."

Sincerely,

The Members of the 21st Century Workforce Commission, June 2000

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Executive Summary

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There is no doubt that the digital revolution is dramatically powering America's transition from the Old Economy to the New Economy. Technology spurs changes in how we learn, work, and go about our daily lives.

American jobs are being, and will continue to be, radically changed by information technology (IT). New jobs will be created, and old jobs will either be eliminated or significantly transformed.

And, as never before, there is, and will increasingly be, a premium on American workers who can read and understand complex material, think analytically, and use technology efficiently.

The 21st Century Workforce Commission was established by Congress to take a "snapshot" of the information technology workforce around the country. The Commission — 17 members with relevant expertise from business, education, labor, and government — was charged with studying and recommending to the President and Congress how best to ensure that American workers have the opportunity to prepare for and succeed in the IT jobs of today and tomorrow.

The 21st Century Workforce Commission believes that:

The current and future health of America's 21st Century Economy depends directly on how broadly and deeply Americans reach a new level of literacy — "21st Century Literacy" — that includes strong academic skills, thinking, reasoning, teamwork skills, and proficiency in using technology.

Drawing from its field hearings, site visits, and existing research, the 21st Century Workforce Commission has identified nine Keys to Success that leaders at all levels can apply to build a highly skilled workforce prepared for high technology job opportunities in the 21st Century.

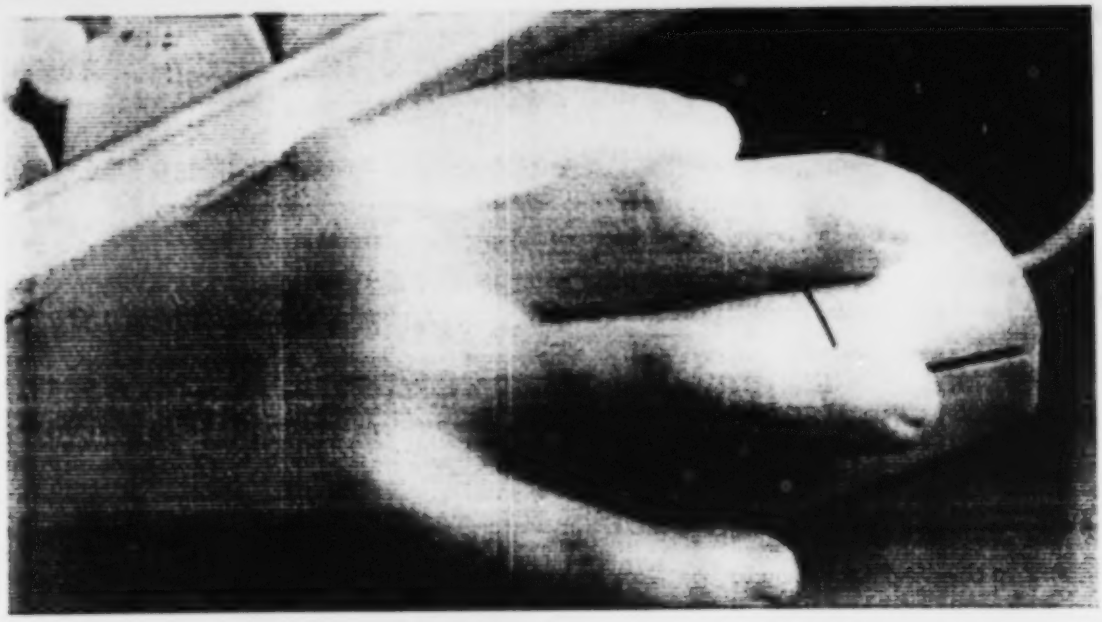
The Keys to Success are:

1. **Building 21st Century Literacy**

   Every American youth and adult needs to acquire 21st Century Literacy — strong academic, thinking, reasoning, and teamwork skills, and proficiency in using technology.

2. **Exercising Leadership Through Partnerships**

   Americans who exercise leadership in regionally and locally based partnerships, supported by well-designed state and federal policies and programs, create the most effective solutions for addressing 21st Century Literacy and IT skills shortages.



3. **Forming Learning Linkages for Youth**

   American high schools need to strengthen their connections with postsecondary education and the workplace to motivate and encourage students toward higher personal goals and give them a realistic sense of the world of work.

4. **Identifying Pathways into IT Jobs**

   American adults and youth need to clearly understand the skills needed for IT employment at various levels and the opportunities for training.

5. **Increasing Acquisition of IT Skills**

   More Americans need to enroll in and complete high-quality information technology programs that provide them with up-to-date skills and knowledge needed to succeed in today's IT workplace.

6. **Expanding Continuous Learning**

   Americans in the 21st Century workplace will need to continuously upgrade their skills and knowledge as new technologies and work patterns emerge.

7. **Shaping a Flexible Immigration Policy for Skilled IT Workers**

   American immigration policy needs to be flexible to address ongoing IT skills shortages.

8. **Raising Student Achievement**

   American schools need to make sustained and continuous improvements so that students are prepared for postsecondary learning and 21st Century jobs.

9. **Making Technology Access and Internet Connectivity Universal**

   Regional and national strategies need to provide for universal access to Internet connectivity and high-speed broadband connectivity, computing technology, and facilitate training for technological literacy.

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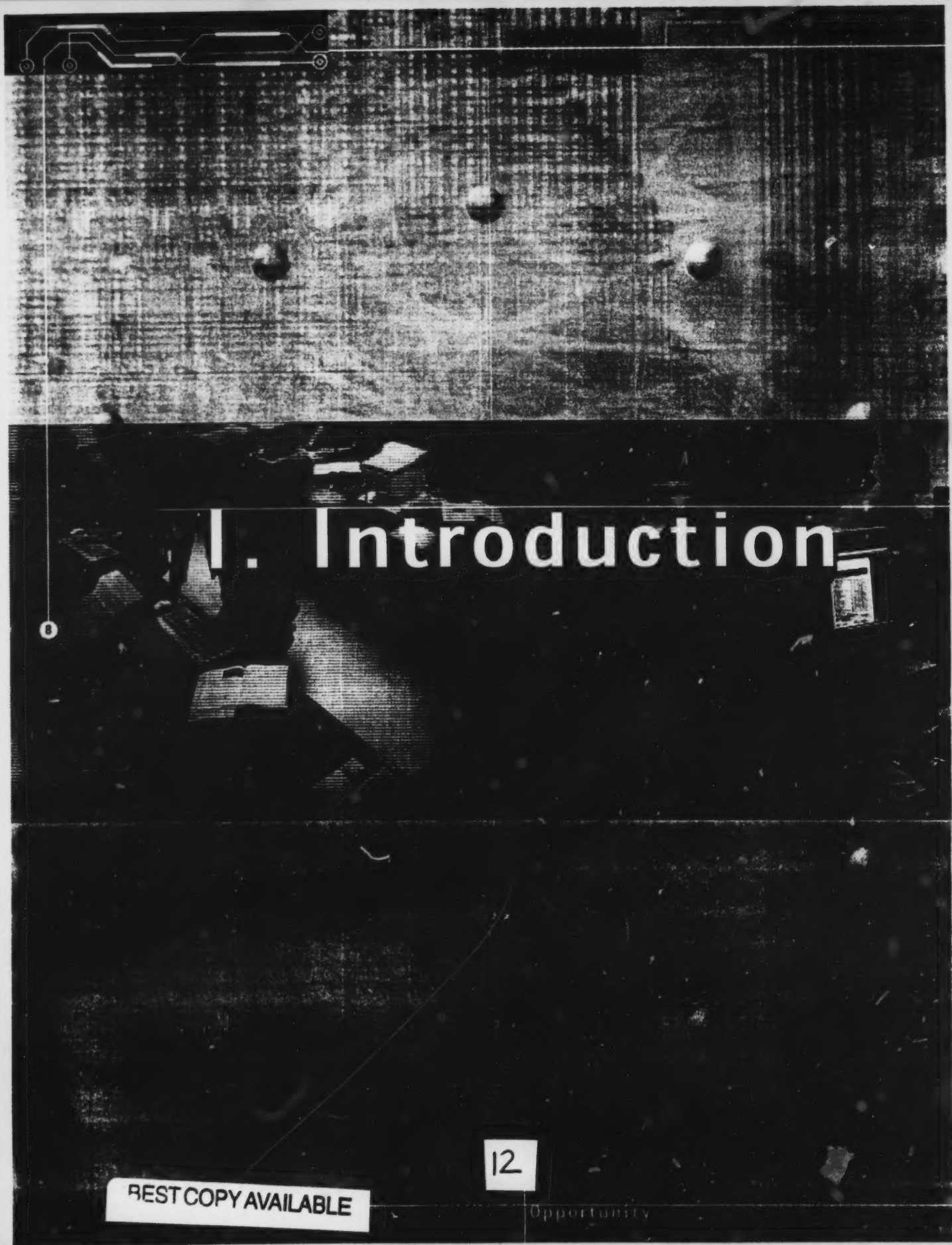
Putting these Keys to Success into practice will require "Leadership Responses" from stakeholders at all levels.

The 21st Century Workforce Commission has found many examples of such leadership in communities across the nation. We encourage each of you, whether you are a member of Congress or a member of the local Lions Club, to act as a leader in your own community and circle of influence.

Through individual leadership and working in partnership with others, we can ensure that every child, youth, and adult reaches a high level of 21st Century Literacy. We can expand the number of individuals qualified to enter high-skill, high-paying information technology jobs and buttress American economic competitiveness well into the 21st Century.

The 21st Century Workforce Commission, June 2000



I. Introduction

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Dynamics of the 21st Century Information Economy

The digital revolution is dramatically powering America's economy and accelerating changes in how we learn, work, and go about our daily lives. During the transition from the Old Economy to the New Information Economy, the fate of specific industrial sectors and particular companies is uncertain. However, any status report on the American economy would reveal that there is an ever-growing need for a workforce that is skilled, knowledgeable, and adaptable to a rapidly changing global landscape.

The Charge of the 21st Century Workforce Commission

The 21st Century Workforce Commission — 17 members with relevant expertise from business, education, labor, and government* — was established by Congress in November, 1999, under the authority of the 1998 Workforce Investment Act (WIA). The Commission was charged with studying and recommending to the President and Congress how best to ensure that American workers have the opportunity to prepare for and succeed in the information technology jobs of today and tomorrow.

The Commission has specifically sought information about:

- Knowledge and skills necessary for IT employment
- Strategies for expanding the number of qualified IT workers
- Best practices and policies related to IT education and training

The Commissioners believed that the challenge of expanding the IT workforce required a broad analysis of potential solutions. This analysis looked at short- and long-term strategies, including initiatives to help more adults access skills and training for IT careers, as well as initiatives that would improve education and expand access to information technology and the Internet.

In early 2000, the Commission held one-day hearings in Jackson, Mississippi; Cupertino, California ("Silicon Valley"); St. Paul, Minnesota; Dallas, Texas; Boston, Massachusetts; and Fairfax, Virginia. The Commission heard from nearly 100 witnesses and interviewed another 200 individuals during various site visits and meetings. Finally, the Commission drew from a wealth of reports and analysis in the public domain, produced by government agencies and non-profit organizations.

The Deepening Impact of Technology

With each day that passes, the impact of new technologies on American jobs is intensifying. The effects of these technological changes on the workplace and the workforce have been pervasive and dramatic in size and speed.

* The Members of the 21st Century Workforce Commission are identified at the end of the report.

By 2006, nearly half of all U.S. workers will be employed in industries that produce or intensively use information technology products and services.[1]

In the near future, every American job will be radically affected by applications of information technology. New jobs and career paths will be created, and old jobs will either be eliminated or significantly transformed.

And, as never before, there will be a premium on American workers who are able to read and understand complex material, think analytically, and use technology efficiently.

The Shortage of Information Technology Workers / The Skills-Gap

During its hearings and site visits, the Commission heard numerous stories about the aggressive headhunting and "poaching" of skilled IT workers in an extremely tight job market. Many employers are in an "instant results" mode. As a consequence, human resources (HR) hiring managers are faced with a decision to "buy" (i.e. pay to bring in talent from outside the company) or "build" (i.e. provide training for current workers). In many circumstances, HR directors are not given the time to develop specialized skills among current employees when a job description is written to fulfill the demands of a new contract. Business demands pressure HR professionals to hire individuals with specific skills who can produce immediate results.

"Our need is so great that in 1999 we started offering recruiting incentives to our employees. Last month, one of our Houston-based engineers won a fully loaded Ford Explorer for making a successful referral."

—Steve Leven, Senior Vice President, Texas Instruments, Inc.

Companies that have a dominant position in the IT industry can "buy" their way out of the skills shortages. Other large companies may decide to "grow their own" by operating internal workforce development programs or contracting for customized training.

Small- and mid-size companies are often the ones left in the lurch. Most IT jobs, as many as nine out of ten, exist in small non-IT companies.[2] But because of their size and rapid expansion, these companies often do not have the financial resources or the time to develop their own workers. They may also fear that investing substantially in the skills of current employees simply makes those workers more attractive "poaching" targets for bigger companies with deeper pockets.

Additionally, many small- and mid-sized businesses either do not know about, or do not have confidence in the value of community-wide workforce development and education initiatives.

Business people may sit on leadership boards of workforce development systems, but, depending on their professional experiences, may not necessarily be attuned to the skills required for IT positions or the fast pace of the IT industry.

Without aggressive outreach to local employers, a workforce development system may not be well-integrated into the local business culture, and therefore, is an under-utilized resource.

Education and training resources at local community colleges, four-year institutions, or private vendors may likewise be under-utilized and not strategically marshalled into a community-wide effort to build a workforce equipped with the technical skills demanded by employers.

The result is that the need for skilled human capital is the most critical component of our nation's economy, and demand for highly skilled workers appears to exceed supply.

Alongside an intense demand and worldwide search for workers, there exist pockets of high unemployment and persistent poverty in rural America, small towns, and inner cities, as well as among disadvantaged communities.

The "Digital Divide" — the gap between those who have access to technology and Internet connectivity and those who do not — reveals significant disparities based on income, race, education, and geography.

America's Changing Face

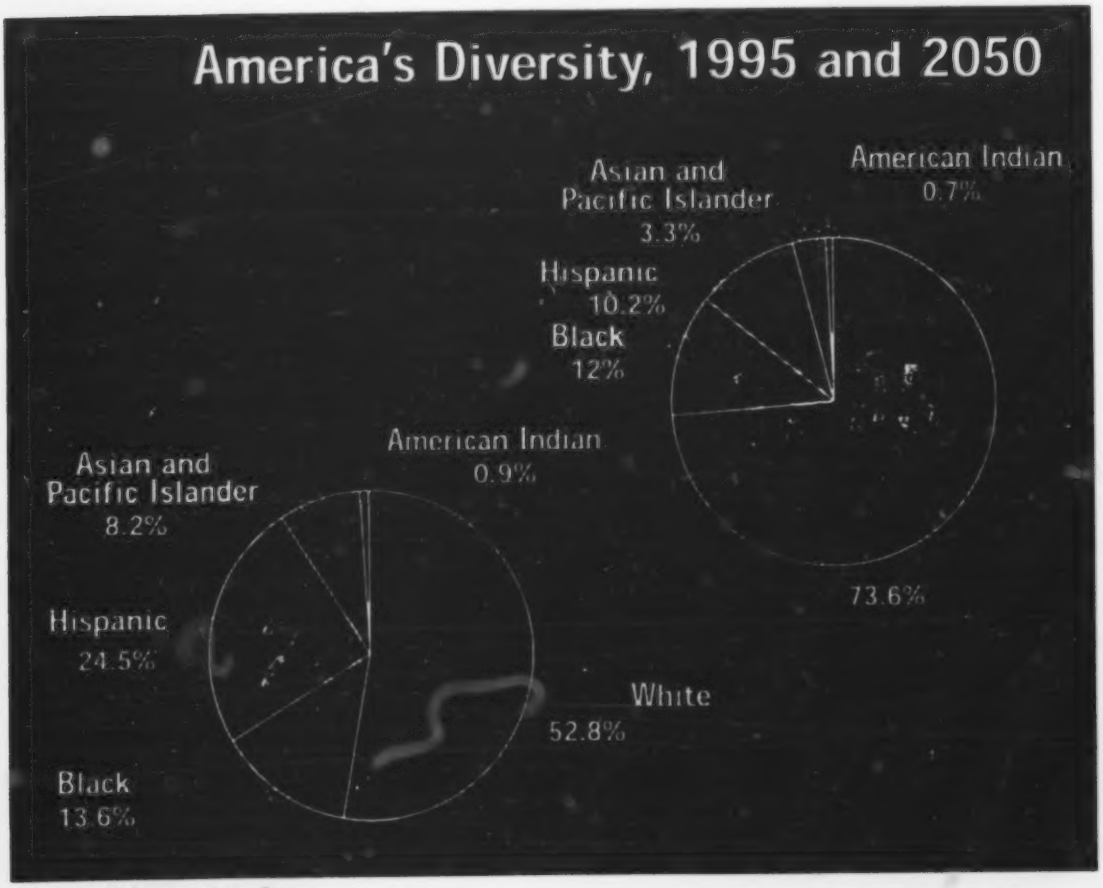
Compounding the problem of current shortages of skilled workers, the United States will undergo dramatic demographic shifts in the coming decades — changes that will affect businesses, government, and cultural institutions.

- During the next 50 years, the United States' population is expected to grow by nearly 50 percent, from about 275 million in year 2000 to more than 390 million in 2050.[3]

"The world is moving to a much more open model, driven by the need to deliver information and services to anyone, anywhere, anytime, on virtually anything."

—Scott McNealy, Chairman and CEO, Sun Microsystems

- Immigration trends, coupled with trends in birth rates, will add more diversity to the American workforce. By 2050, the percentage of minorities will increase from one in every four Americans to nearly one in two.[4]
- The number of children and youth enrolled in school is at its highest level ever — 53.2 million in 1999. This number is projected to increase to almost 54.2 million by 2009.[5]
- Americans will continue to live longer, with life expectancy extending to 82 years in 2050.[6]



Source: U.S. Bureau of the Census

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The Mandate for 21st Century Literacy

The trends are clear and profound:

- America's population is growing and becoming more diverse.
- More children are enrolling in our nation's schools, increasing the pressure on the capacity of schools and straining the resources of qualified teachers.
- Too many adults are entering the U.S. workforce with poor basic academic and workplace skills, far from the high level of technical skills required for IT employment.
- The "Digital Divide," the documented inequity of access to computers and the Internet for certain groups, threatens to exacerbate the economic disparities that already exist based on education and other factors.

These trends present the American education and training systems with an enormous challenge: To expand the capacity to help learners, both young and old, attain high levels of academic and technical skills achievement.

If American companies cannot fulfill their requirements for information technology and other technical jobs with qualified workers, ultimately America's economic competitiveness will suffer.

The Commission has concluded:

The current and future health of America's 21st Century High Technology Economy depends directly on how broadly and deeply Americans reach a new level of literacy — "21st Century Literacy" — that includes strong academic, thinking, reasoning, and teamwork skills, and proficiency in using technology. ◘

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"One of the most effective ways for small companies to meet their needs is through collaborative training efforts — partnering with universities, with other companies, and/or (IT industry) organizations."

—Joyce L. Plotkin, President, Massachusetts Software and Internet Council

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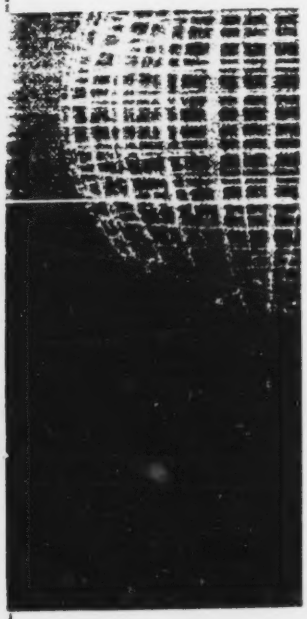
What Exactly is an IT Worker?

The term "IT worker" may evoke the image of a "geek" with a pocket protector who writes detailed computer code for hours on end; or, it may represent a brilliant, hip, 20-something who makes instant millions from stock options in a start-up "dot com" company.

The Commission raises the definition beyond the stereotypes, identifying an IT worker as an individual who is responsible for designing, building and/or maintaining an information technology infrastructure that businesses and consumers use.

An IT worker is not someone who simply uses a word processing application to prepare a document, inputs directions to a milling machine through a computer interface, or operates a computer to diagnose an automotive repair. Such a worker may hold a job that is "IT-enabled," but for purposes of this report, the Commission did not define such an individual as an IT worker, even though he or she will need to be proficient in the use of technology.



Core IT Professions

A limited group of occupations, while clearly not including all IT workers, has been characterized as the "Core IT Professions" by the U.S. Department of Commerce's Office of Technology Policy.[3] These occupations, most of which require a four-year degree in a technical field, are described below:[4]

- Computer Scientists design computers and conduct research to improve their design or use. These IT workers use a high level of theoretical expertise and innovation to solve complex technical problems.
- Computer Engineers work with the hardware and software aspects of systems design and development, often as part of design or testing teams.
- Systems Analysts study business, scientific, or engineering data processing problems and design new solutions using computers.
- Database Administrators work with database management systems software and determine ways to organize and store data.
- Computer Support Specialists provide technical assistance, support, and advice to customers and users.
- Computer Programmers write and maintain the detailed instructions called "programs" or "software" that perform functions.

IT Skills Clusters

Drawing on the input of business, workers, and educators, the NorthWest Center for Emerging Technologies (NWCET), with the support of National Science Foundation

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Creators, Implementers and Users of Information Technology

	CREATORS of Information Technology	IMPLEMENTERS of Information Technology	USERS of Information Technology
ROLE	Design & Build IT systems and components	Install, Operate, Maintain & Support IT systems	Use computer-based systems in their work
EXAMPLE OCCUPATIONS	Programmers Web Designers Assemblers EE Engineers	Network Administrators PC Technicians Technical Support Website Maintainers	Accountants Graphic Artists Data Entry Administrative Assistants

Source: Dennis White, The Compass Group, January 27, 2000

(NSF) and National School-to-Work funding, identified several clusters of IT jobs. NWCET developed a set of skills standards for jobs in these clusters.[9] These standards identify the prevailing knowledge, skills, and abilities required of IT workers in these areas.

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The eight skill clusters represent general groupings around which dozens of specific job titles can be organized.[10] These clusters include the Core IT Professions identified by the Department of Commerce. The training required for these IT jobs ranges from on-the-job training to post-baccalaureate advanced degrees.

The skills clusters include:

- Database Development and Administration: gathering and organizing data and designing reports that respond to customer needs.
- Digital Media: applying artistic talents, marketing knowledge, and expert use of digital design software tools to create visual products responsive to customer needs.
- Enterprise Systems Analysis and Integration: making multiple software and hardware systems work together, increasingly to facilitate digital commerce or "e-business."
- Network Design and Administration: designing, maintaining, and upgrading network hardware and software to link an organization's network systems with its users, customers, and other networks.
- Programming/Software Engineering: using technical analysis and business operations knowledge to design and create software.

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- Technical Support: helping users with technology applications and solving hardware or software operation and application problems.
- Technical Writing: creating manuals, writing computer specifications, providing content for online help, and authoring World Wide Web content.
- Web Development and Administration: designing, implementing, and maintaining an organization's presence on the World Wide Web.

Which IT Jobs are in Demand?

Estimates of the demand for IT jobs vary widely, depending on which definitions of IT workers are used and how demand is measured.

Federal Data Projections. On the conservative end of the spectrum, estimates generated by Bureau of Labor Statistics (BLS) project demand for Core IT Professions that generally require a four-year degree.

- The BLS employment projections indicate that, between 1998 and 2008, more than two million new skilled IT workers will be needed to fill newly created jobs and to replace IT workers leaving the field.[11]
- BLS projections predict an average annual demand of approximately 200,000 skilled IT workers in occupations such as computer support specialists, database administrators, computer scientists and engineers, systems analysts, and computer programmers.
- About three-quarters of these jobs are projected to be in IT occupations normally requiring at least a bachelor's degree.[12]
- The remaining quarter of high-demand positions are projected to be in IT occupations that require an associate's degree.

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ITAA Research: Using the broader definition of IT workers as defined by the NorthWest Center for Emerging Technologies, the Information Technology Association of America (ITAA) polled 700 IT and non-IT company hiring directors. It projected a much larger IT workforce and a correspondingly larger current job gap in IT occupations.[13]

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- In April 2000, ITAA estimated that at least 10 million people are part of the IT workforce.
- Nearly one million IT workers are employed by IT companies, while approximately nine million IT workers are employed by non-IT companies.
- According to responses from hiring managers in the companies polled, the ITAA analysis indicates a demand for 1.6 million new workers over the next 12 months. It predicts more than 840,000 open IT jobs will go unfilled. [14]

According to ITAA, the three "hottest" IT jobs are: Technical Support, Database Administration, and Computer Programming. These three categories represent 68 percent of all IT job demand, with the greatest need for IT workers in small non-IT firms. Non-IT firms are companies that are profoundly affected by technology, such as financial services and retailing, but where technology is not their core line of business.

It should be noted that the ITAA analysis represents approximate employer projections, not precise measurements of unfilled job vacancies. In fact, there are no precise methodologies for measuring IT job vacancies. ◘

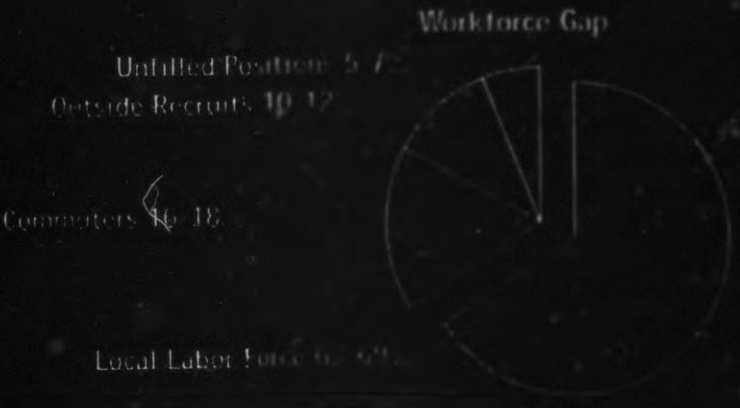
Silicon Valley's Unmet Labor Demand

The 1999 Workforce Study, produced by Joint Venture: Silicon Valley Network, found that the demand for skilled high-tech labor among Valley firms is fully one-third greater than the capacity of Silicon Valley's domestic high-tech workforce.

The Valley's workforce gap — the number of jobs that are not filled by people from the area — is 160,000. Some of these jobs are filled by long-distance commuters, some by people who voluntarily move into the region from other areas. And some jobs — five to seven percent of total demand — simply go unfilled.

SPECIAL ANALYSIS: SILICON VALLEY'S DIGITAL DIVIDE

High-Tech Labor Demand Unmet by Silicon Valley Workforce



Workforce Demand of High-Tech Industry Cluster

Source: Joint Venture: Silicon Valley Network (from statement presented by Ruben Barrales, January 27, 2000, Cupertino, California)

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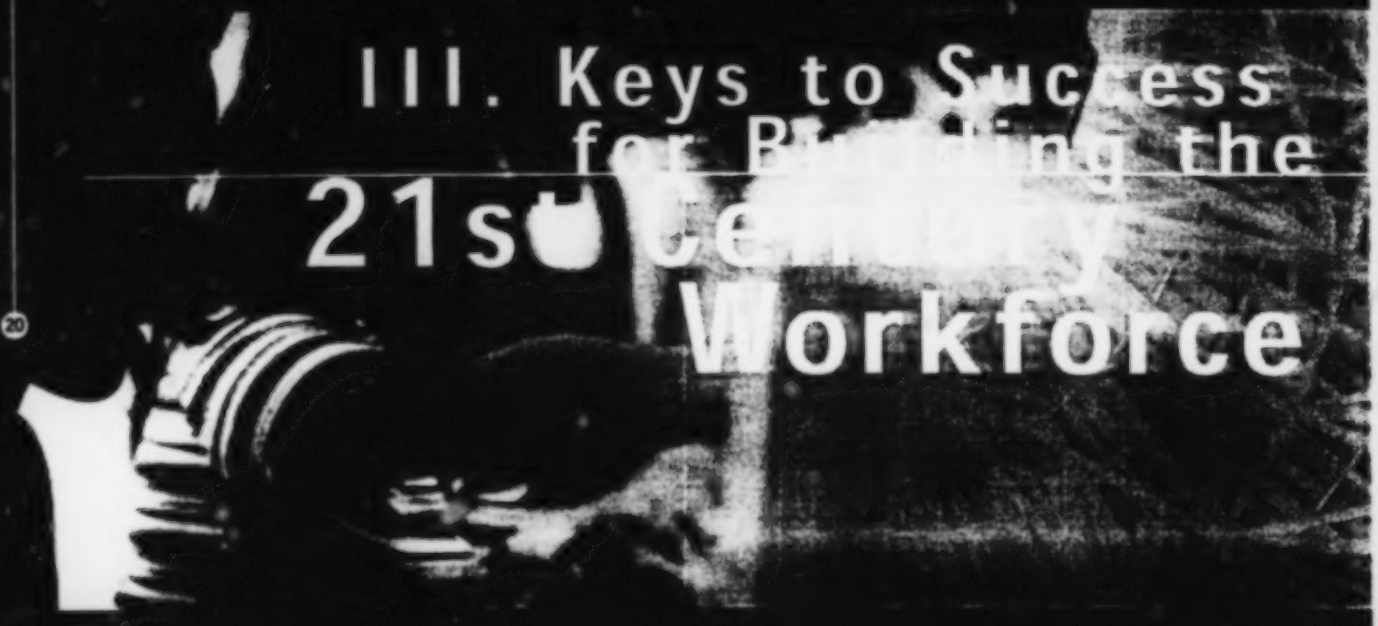

III. Keys to Success for Preparing the 21st Century Workforce

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In light of the significant growth in jobs projected for the IT workforce, it is clear that America must develop and implement strategies to sharply increase the number of well-educated, highly skilled workers who are ready to fill these positions.

The Commission has identified nine "Keys to Success," all of which are predicated on 21st Century Literacy and Exercising Leadership through Partnerships.

The Keys to Success fall into two broad categories. The first category concentrates on building today's workforce and highlights strategies that immediately affect youth approaching graduation from high school and postsecondary education, as well as adults who are already in the workforce.

The second category focuses on building tomorrow's workforce. It highlights strengthening K-12 education and providing universal Internet connectivity, strategies that will

lay a critical foundation for long-term success in providing Americans with 21st Century Literacy and increasing the number of youth and adults qualified to succeed in IT education and training programs.

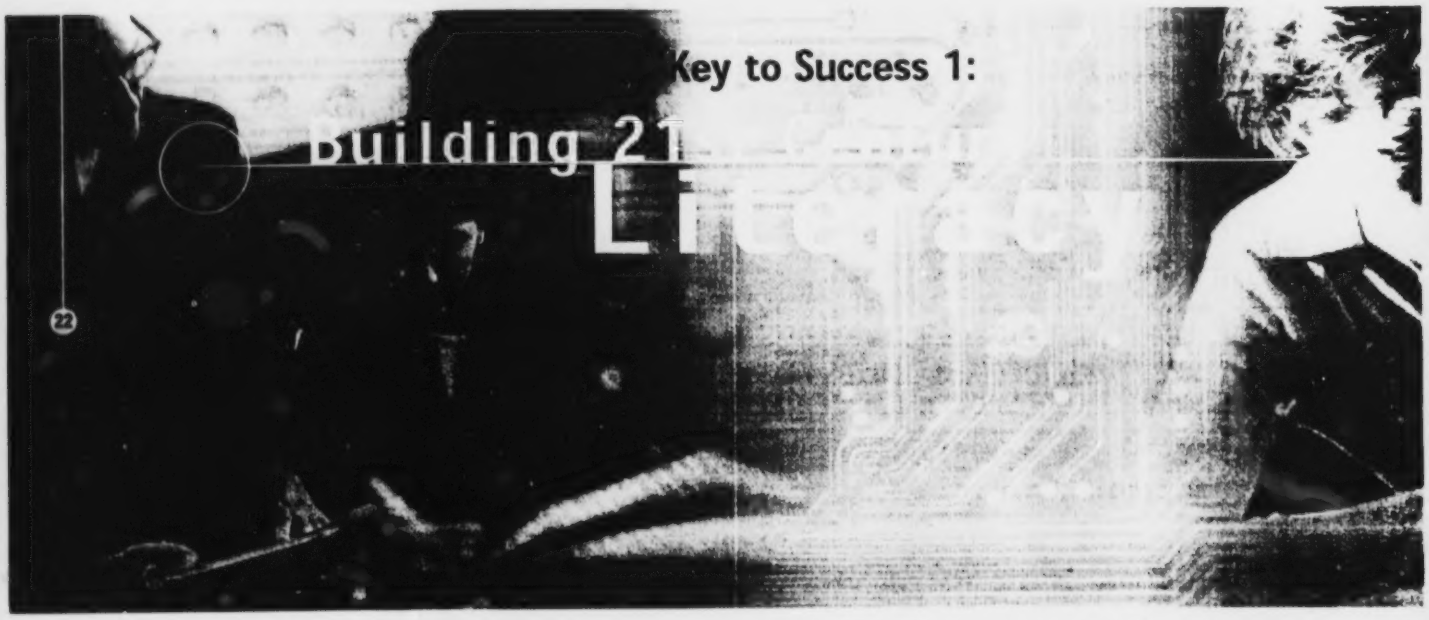
Under each Key to Success, the Commission has identified a number of "Leadership Responses." These Leadership Responses offer opportunities for success to leaders who are serious about breaking free from the status quo and achieving results.

In the complementary web-based *eHandbook of Promising Practices and Resources* prepared by the Commission, the reader will find extensive examples of partnerships, organizations, and government initiatives around the nation, as well as abroad, that form the basis for Keys to Success and Leadership Responses.[15] The Commission urges the reader to use the *eHandbook* as a resource to create customized local and regional solutions to IT workforce shortages. The handbook is online at the Commission's web-site: http://www.workforce21.org.

Every American youth and adult needs to acquire 21st Century Literacy — strong academic, thinking, reasoning, and teamwork skills, and proficiency in using technology.

Today, more than ever, literacy is a powerful determinant of an individual's and a nation's opportunity for economic success. Research has shown that rapidly expanding market sectors tend to have a highly literate and skilled workforce.[16]

A defining feature of the Information Economy is a new breed of "knowledge workers" who work with their brains instead of their backs. To compete, today's successful workers must have acquired "21st Century Literacy," defined by the Commission as the ability to read, write, and compute with competence, think analytically, adapt to change, work in teams, and use technology.



The Commission notes that "21st Century Literacy" builds on the foundation of "20th Century Literacy." In the 20th Century, the benchmark for literacy was meeting a basic threshold of reading, writing, and mathematical computing ability. This literacy level was sufficient for the Industrial Age, but today's jobs require these basic skills as well as a higher level of academic, workplace, and technical skills. The literacy bar was raised decade by decade during the last century, and continues to rise.

In calling for "21st Century Literacy," the Commission acknowledges the effect that information technology has had, and will continue to have, on how Americans live and work. The ability to use information technology at a basic level is increasingly critical to: function in modern American society, engage in continuous learning, and participate in civic life.

The Relevance of 21st Century Literacy to Developing the IT Workforce

For learners to successfully complete IT postsecondary education and training and be competent IT workers, they must first possess "21st Century Literacy."

Many IT jobs require, at a minimum, an associate's degree and/or specific postsecondary school certifications attained through specialized technical training. A large percentage of IT jobs requires a postsecondary education degree, with rigorous computer science and engineering degree programs representing the primary path to the Core IT Professions.[17] These requirements reflect general labor market trends in which a premium is placed on advanced education and training. For example:

- Individuals who have more education and training typically earn more than individuals with less education and training — a trend that has accelerated in recent decades. In 1975, the average college graduate earned 57 percent more than the typical high school graduate.[18] In 1997, the average college graduate made 77 percent more than the typical high school graduate — $40,478 compared to $22,895.[19]

- Between 1996 and 2006, jobs requiring a bachelor's degrees are projected to increase by 25 percent, nearly double the predicted national average.[20]
- In 1959, only 20 percent of jobs held by workers ages 30 to 59 required some postsecondary education. Today, about 56 percent of jobs for these workers require some postsecondary experience.[21]

"I can tell your that our findings indicate that technical skills must be combined with what I would call "employability skills" – written and oral communication strength, project management, problem solving and analytical skills."

—Harris Miller, President,
Information Technology Association of America (ITAA)

Challenges to Building 21st Century Literacy

Living on the Other Side of the Skills Gap

Unfortunately, despite the importance of attaining "21st Century Literacy," far too many high school graduates, entrants into postsecondary education, and American adults in the labor force cannot read or compute at a level adequate to complete postsecondary education and training or compete in the IT labor market.

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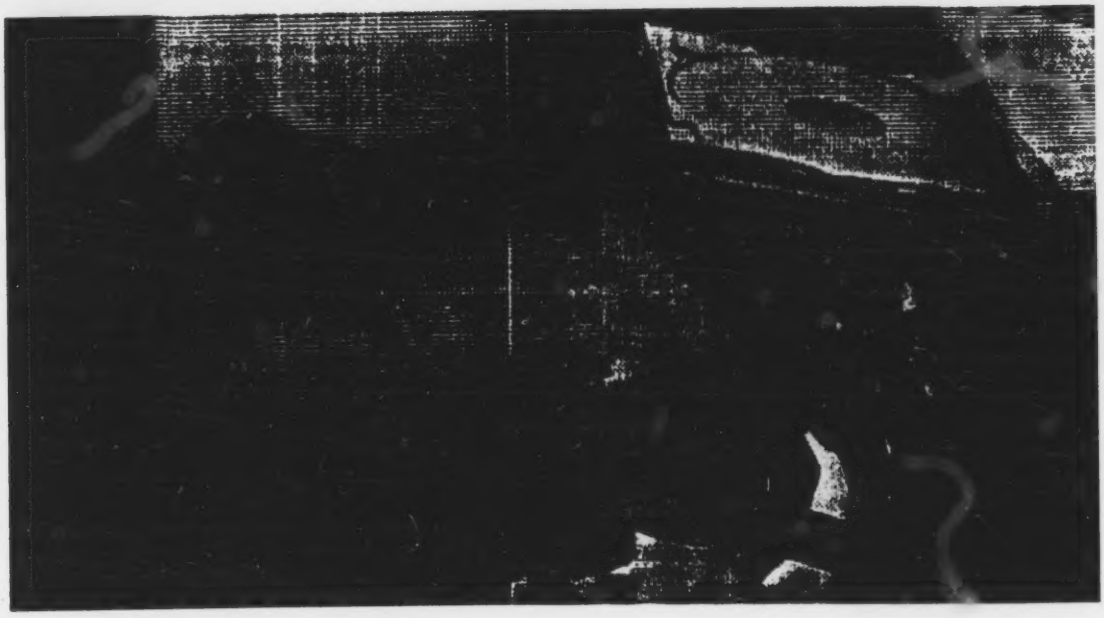

"IT workers are not a separate or elite class: In a high value-added economy, all workers must be educated, trained, and empowered to be IT workers."

—Thomas A. Kochan, MIT Sloan School of Management

According to the 1992 National Adult Literacy Survey (NALS)[22], approximately 90 million adults — nearly half of the adult population — have skills in the lowest two of four levels on the literacy scale used for the survey. The NALS literacy scales measure prose literacy (skill in understanding information from text), document literacy (the ability to locate information in various formats such as forms and tables), and quantitative literacy (knowledge required to apply arithmetic operations to solve problems).

Only three to five percent of adults surveyed scored at the highest literacy proficiency levels. Young adults aged 21 to 25 — those most likely to move immediately into the labor force — had reading, document literacy, and math skills lower than the skills of young workers tested on the same assessment a decade prior to the study. Many researchers surmise that the drop was due in part to the large number of young immigrant adults learning English as a second language.

The following paragraphs describe what it means to be functioning at the lowest literacy levels:

- Adults scoring at Level One can read and do math well enough to perform simple tasks, such as finding a piece of information in a news article, locating the time and place for a meeting on a form, or totaling entries on a deposit slip.

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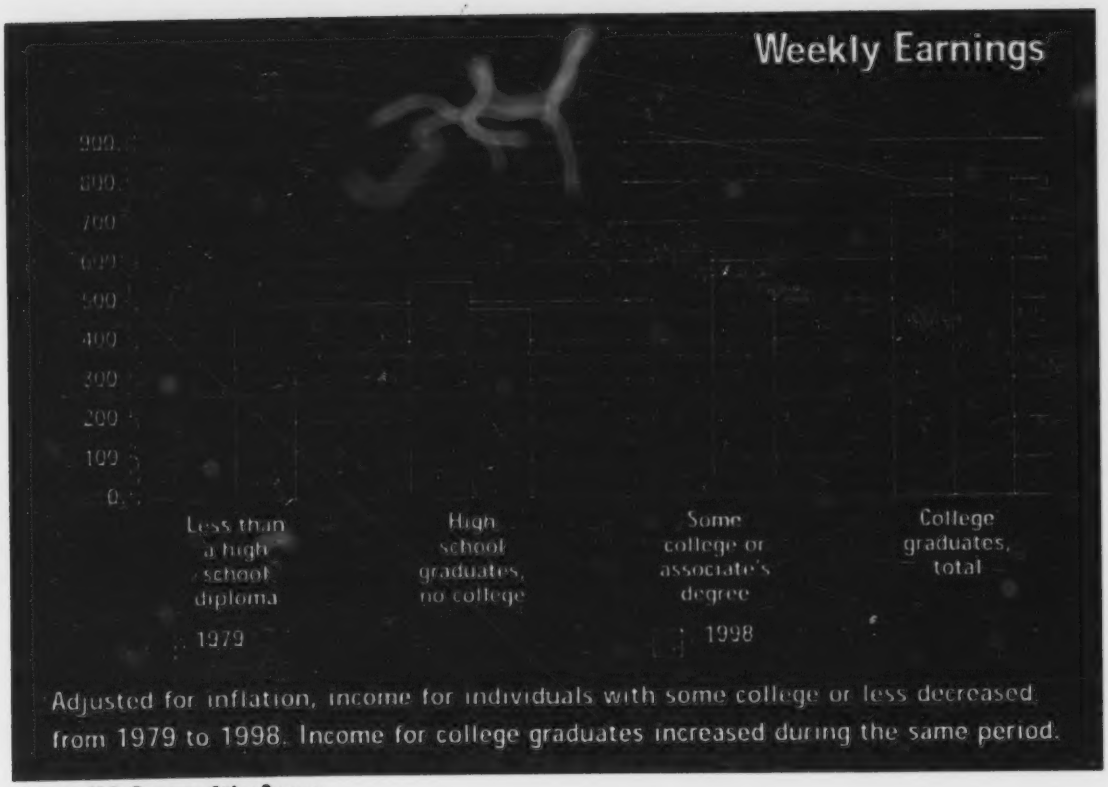

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Source: U.S. Bureau of the Census

- **Adults scoring at Level Two can read and do math well enough to make simple conclusions about written material, integrate easily identifiable information, and calculate the difference in price between two items.**
- **Adults scoring at both Levels One and Two have great difficulty in integrating information that is more complex or doing math problems that require more than one operation to get an answer."**

The large number of young and older American adults with low literacy skills presents a daunting dual challenge to ensuring that all Americans possess "21st Century Literacy." To address this twofold challenge, the Commission believes that it is imperative that the nation:

1. **Upgrade substantially the skills of millions of adult workers so that they are prepared to continue learning and training for jobs that demand high-tech skills.**
2. **Ensure that all students currently in the K-12 system — America's future labor force — graduate with "21st Century Literacy" and are prepared for post-secondary education and training and high-tech careers.**

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Trends and Practices in Building 21st Century Literacy*

Federal funding for adult education has expanded rapidly in recent years. New legislation is fostering the creation of quality programs that integrate technology into instruction. Congress is also increasingly focusing on learning outcomes. In addition, federal funds are being targeted specifically to improving English as a second language (ESL) instruction for recent immigrants and new citizens.

But much remains to be done. Education and training programs need to be improved and expanded rapidly to bring adults to higher levels of literacy, including technological literacy. Correctly applied, technology can be used to enhance the learning experience. It can also be used to accelerate acquisition of knowledge and skills, simultaneously strengthening technological literacy.

As an example of a strategic approach to enhancing adult literacy, Georgia has launched a systematic county-by-county campaign to assess the literacy skills of adults, create an action plan that mobilizes all sectors of the community, and set clear benchmarks for action and measuring results.

"What has become clear to Texas Instruments and other companies is that we cannot stand by and hope that the situation will improve. We need to be involved to help ensure that our schools are teaching kids what they need to know while making sure that they graduate with the skills they need to succeed in a technology and information-rich society."

—Steve Leven, Senior Vice President, Texas Instruments, Inc.

Leadership Response to Building 21st Century Literacy

- All leaders who are concerned with ensuring the economic and civic health of the nation should take action, based on the Keys to Success identified in this report, to help all Americans gain 21st Century Literacy. Leadership Responses include the following:

* Trends, Practices, and Leadership Responses related to raising the skills of youth will be discussed in "Key to Success" Sections Three (Learning Linkages for Youth) and Eight (Raising Student Achievement), which explore the necessary long-term actions for ensuring that America meets its general and IT specific workforce challenges.

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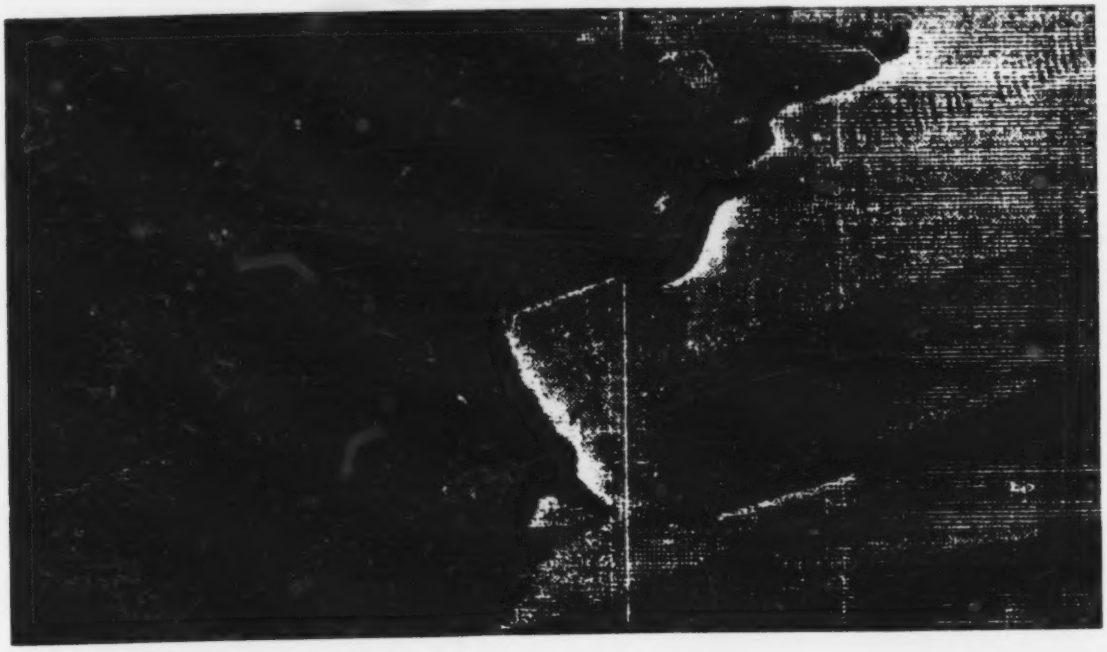
- Each community will need to develop customized strategies for how it will target education and training opportunities to help all youth and adults acquire 21st Century Literacy, adopting new approaches, strategies, assessments, and measuring progress.
- Partnerships will need to be created for education and training that cut across traditional boundaries and engage stakeholders to work together to achieve results.
- To cultivate a higher level of technological literacy among adults, community centers and libraries should make technology and Internet connectivity widely available for adults and children.
- Technology applications should be integrated into adult basic education, ESL, and welfare-to-work programs.
- To make IT skills training opportunities accessible to adult learners, leaders should create new connections between adult basic education, ESL instruction, and welfare-to-work programs. Education and training programs for adults must incorporate the acquisition of basic technology skills and pathways to training in higher level IT skills.
- To assist students who have advanced to upper grades without mastering the basics of reading and math, schools and community organizations should offer intensive, accelerated interventions to get students back on track and move them into alternative programs if they drop out. ■



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Americans who exercise leadership in regionally and locally based partnerships, supported by well-designed state and federal policies and programs, create the most effective solutions for addressing 21st Century Literacy and IT skills shortages.

In the workplace, there has been a major shift away from individualized, repetitive work. Employers and employees now see the value of teamwork in which team members take mutual responsibility for their work, with each member providing creativity and innovation to continually improve results for which the team is held accountable.

A similar cultural shift is occurring in how Americans view human capital development. Businesses, schools, postsecondary institutions, employee organizations, and local governments are learning how strategic collaboration, linked with existing

Key to Success 2:

Exercising Leadership Through Partnerships

program funding, infrastructure and staff, is an efficient way to achieve results in IT skills training.

In today's demanding world, no single business, group of workers, educational institution, or government agency can single-handedly tackle the challenge of educating America's workforce to the high levels of 21st Century Literacy.

Relevance of Exercising Leadership Through Partnerships to Developing the IT Workforce

Regions intent on succeeding in the Information Economy can best accomplish their goals by developing partnerships that include a high degree of business involvement with a focus on developing a highly skilled IT workforce.

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The Commission learned that collaborative approaches offer significant advantages to small- and mid-sized businesses that want to play an active role in workforce development. In the new technology jargon, the term "Coop-etition" describes how rival companies compete in some technologies while cooperating on other projects when it is to their mutual advantage. Developing a skilled workforce and improving the academic and technical skills of youth and adults are clear areas of mutual advantage around which businesses can cooperate.

The 21st Century Workforce Commission is calling for a commitment from local leaders in which stakeholders create partnerships to get results, rather than stand separately to allocate blame.

The types, sizes, and varieties of successful partnerships are numerous. The deciding factor is strong leadership which helps to forge binding connections between the stakeholders. The results of such collaboration can be much more powerful than when organizations try to work independently.

Challenges to Exercising Leadership Through Partnerships

Multiple institutional and programmatic challenges would prevent individuals from exercising leadership through partnerships.

"As employers, our greatest challenge today is to find and develop a well-trained workforce. What better way to prepare your future workforce than to be involved in the content and progress of their skill base?"

—Keith Reimer, Vice President of Sales, Compuquik, describing the Texas Scholars Program.

- Isolation. Educational systems, postsecondary institutions, and workforce training programs have strong traditions of carrying out their operations without coordinating services or engaging in joint planning among institutions and programs.
- Visibility. Many businesses, particularly those that are new or in a high-growth phase, are unaware of the existence of many education and training resources. Other business leaders who have had negative experiences with workforce development programs, schools, or postsecondary institutions in the past may believe the systems are too intractable to be of any value in addressing IT skills shortages.
- Disincentives. Funding allocations may be too small, thus creating disincentives to building IT training programs. For example, some funding formulas for colleges are based solely on student head counts and do not make allowances for the higher costs of technology procurement that IT skills training programs require.

- **Narrow Uses, or Perceived Narrow Uses.** Other funding formulas may be narrowly targeted toward specific participants or specific allowable costs. As a consequence, some funding may be difficult to merge with other funding sources to support a multi-faceted project for building 21st Century Literacy or developing the IT workforce. Conversely, the funding itself may not be narrowly restricted, but local leaders may mistakenly perceive it to be.

Trends and Practices in Exercising Leadership Through Partnership

During hearings and site visits, the Commission identified many models of effective partnerships that are addressing regional IT workforce shortages and helping workers acquire 21st Century Literacy.

The Heinz Foundation Report notes the qualities of successful regional partnerships:

- Encourage and foster entrepreneurship. New businesses are frequently incubators for innovation.
- Regional innovation builds on networks. Networks of people have a better capacity to expand knowledge than individuals in isolation.
- Innovation builds on local assets: talent, infrastructure, and the quality of community life.

Communities can help a region generate innovation and new technology by building people networks, investing in assets particularly its people, connecting entrepreneurs with networks and assets, and by creating a living environment that provides its citizens with a good quality of life.

Source: Statement, Mike Curran, NOVA-PIC

- **"Sematech", a consortium of semiconducting manufacturing companies, identified major shortages in the pool of people with the skills necessary for the industry to grow. In response to this shortage, Sematech created a workforce development initiative with the objective of expanding the pool of skilled workers. The initiative more than doubled the number of community colleges offering the training; so marketing of the industry and the job/career was likewise increased. In support of the initiative, Sematech also worked with the Maricopa Advanced Technology Education Center[37] (MATEC), funded through the National Science Foundation, to develop community college curriculum and faculty development.**
- **The Communications Workers of America, Stanly Community College, and Cisco Systems, with grant funding from the U.S. Department of Labor, created a partnership that provides effective distance education training so that workers can keep their skills up-to-date, and veterans departing from the military can acquire IT skills demanded by the private sector.[38]**

Note: More details about these and similar initiatives are in the Commission's eHandbook of Promising Practices at www.workforce21.org.

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"Educational institutions must form partnerships with IT industry leaders. Academia and IT leaders in the private sector must work together for America's colleges to meet the challenge of providing the skilled workforce necessary to sustain our economy."

—Dr. Michael Taylor, President, Stanly Community College

Technology Opportunity Partnerships

The Commission observed several excellent examples of regional and local collaborative initiatives that focus on IT skills development and education reform. The Commission grouped these initiatives under the term Technology Opportunity Partnerships (TOPs). TOPs can be based within a particular labor market or a geographical region. TOPs can also involve a multi-state region.

To some degree, federal funds from agencies such as the U.S. Departments of Labor, Education, and Commerce have begun to provide support for partnerships that focus on IT skills training. New legislative proposals relating to the TOPs concept are also under consideration by members of Congress.

Leadership Response to Exercising Leadership Through Partnerships

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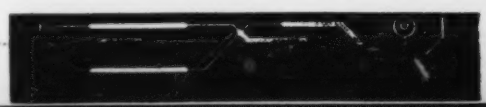
—Technology Opportunity Partnerships: **Businesses and business-led organizations, educational institutions, schools, labor unions, community-based organizations, and local and state governments should work together to create Technology Opportunity Partnerships (TOPs). These partnerships should analyze the general levels of "21st Century Literacy" among residents and the technology skills gaps that exist in a locality or region and create a multi-faceted strategy for addressing them. The strategies should include goals and action steps to address, at a minimum, the following issues:**

- **Raising student achievement in K-12 education.**
- **Forming stronger linkages between middle and high school students and the world of work and postsecondary education.**
- **Identifying clear pathways for youth and adults to enter IT careers.**
- **Increasing the numbers of workers who acquire marketable IT skills in postsecondary education programs.**
- **Expanding continuous learning opportunities.**
- **Increasing access to information technology and Internet connectivity among all segments of the population.**



— Technology Opportunity Partnerships: Congress and the Executive Branch should create a package of federal incentives, including greater flexibility in the use of related federal program funds, to encourage the development of Technology Opportunity Partnerships.

— Seed Funding for Technology Opportunity Partnerships: Federal funds should be used to "seed" the development of Technology Opportunity Partnerships, either for strategic planning activities by existing initiatives or for the creation of new initiatives.

— Technical Assistance Support: The Executive Branch should provide funding to one or more experienced and successful Technology Opportunity Partnerships. These selected TOPs can dedicate staff and resources to provide hands-on and on-line technical assistance to other emerging Technology Opportunity Partnerships.

— Raising Visibility of IT Skills Issues: To support the development of new Technology Opportunity Partnerships, the federal government should sustain an effort focusing on IT workforce issues, conduct regional workshops to assist emerging partnerships, and share best practices.

— Inter-Agency Coordination for IT Skills: The White House should lead an inter-agency working group within the federal government that specifically focuses on the development of a high-technology, high-skills workforce. At a minimum, the working group should include the Departments of Commerce, Education, Labor, Treasury, and the National Science Foundation.

— Federal Agency Support: The inter-agency federal working group should advocate within federal agencies on behalf of Technology Opportunity Partnerships for program flexibility that is linked to specific, results-oriented strategic plans.

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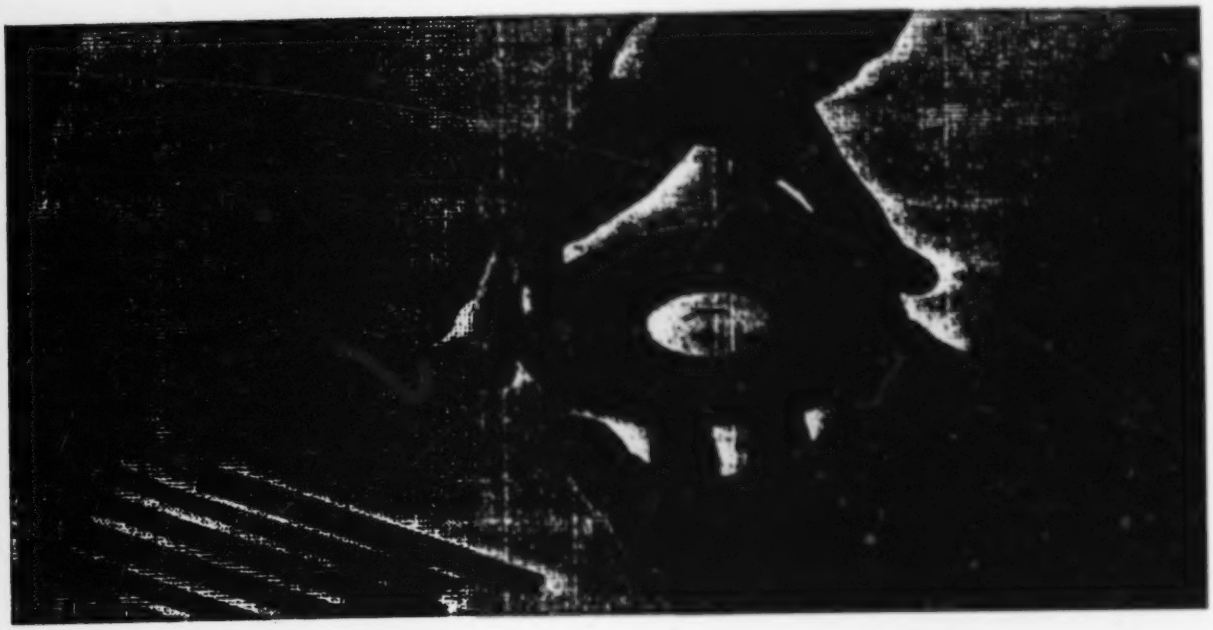
—Strategic Planning for IT Skills: Each agency involved in the working group should adopt performance goals ensuring its programs and policies are relevant to development of skills and knowledge for Information Economy jobs. These performance goals should be included in each agency's strategic plan as required by the Government Performance and Results Act (GPRA). Agency activities should incorporate, at a minimum, the following strategies:

- Identify Barriers to High-Tech Skills: Gather information about statutory requirements, including program rules and regulations, within each agency and across federal agencies that inhibit the development of flexible, collaborative partnerships among local institutions working to develop an IT workforce. This federal working group should report its findings to Congress and the Executive Branch.



- Make Best Practices Available Through Web Resources: The Executive Branch should develop, maintain, and publicize a web-site of best practices in IT workforce development. The current "www.go4ITgov" web-site, operated by the Department of Commerce, could form the basis of this project. Alternatively, the project could be delegated to a successful Technology Opportunity Partnership.
- Enhance Data Gathering: The Executive Branch should assess the adequacy of existing data sources on the IT workforce and take the steps needed to ensure that the size, dimensions and characteristics of the IT workforce are accurately measured over time. ■

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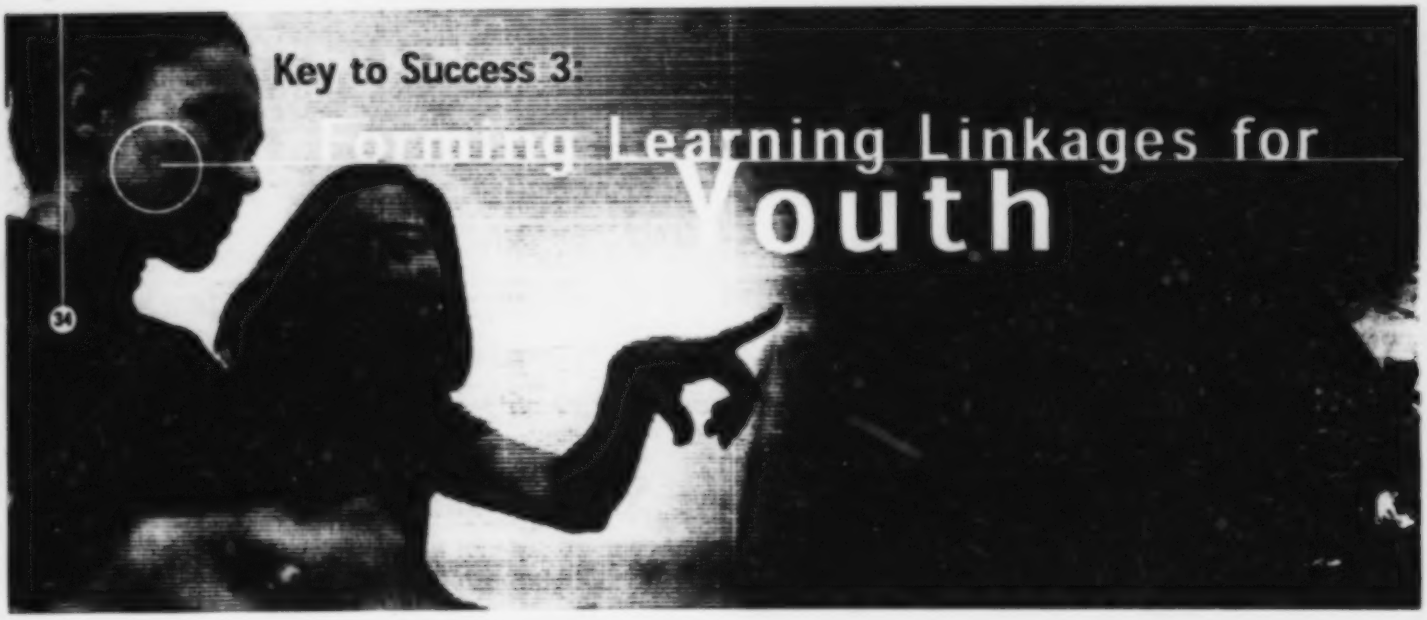
American high schools need to strengthen their connections with postsecondary education and the workplace to motivate and encourage students toward higher personal goals and give them a realistic sense of the world of work.

In its hearings and site visits, the Commission saw how educators and business leaders are working together to create a multitude of innovative and thoughtful programs that integrate learning and the world of work. Employer involvement in school and postsecondary education programs provides critical links between students' school experiences and the requirements for success in the workplace.

As students see the connections between their schoolwork and the skills required for rewarding careers, they begin to understand the importance of learning and can make better decisions about their futures.



The Relevance of Forming Learning Linkages for Youth to Developing the IT Workforce

Improving the achievement of high school students in math, science, and other core academic subjects is critical to meeting the IT workforce needs of the future. Students need higher-level math, science, and engineering knowledge and skills to succeed in IT skills training.

In 1983, the National Commission on Excellence in Education recommended in *A Nation At Risk*[27] that all high school students complete a more rigorous "New Basics" curriculum consisting of four years of English and three years each of math, science, and social studies. While students today are more likely to take higher-level math and science courses than their counterparts in 1983, the *Nation At Risk* recommen-

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dations remain unfulfilled. In 1998, only 55 percent of high school graduates completed the "New Basics" course work.

Increasing the academic rigor of American high schools requires more than making challenging courses available to students and encouraging enrollment. Some students will always pursue and master challenging courses. As Samuel Halperin has noted, a "forgotten half" of students often fall through the cracks of the average American high school.[20] These students are disengaged from learning, and achieve well below their potential. They are bored with school and are just "getting by." They are reluctant to enroll in more challenging courses, doubting or not understanding the relevance of these courses to their educational and career goals. These students may graduate with a diploma, but they leave high school without the solid educational foundation they need to succeed in postsecondary education and rewarding careers.

Schools and communities can re-engage such "average" students in learning, help them achieve at higher levels, and prepare them for further education and career opportunities in the IT industry by creating stronger linkages between their high school experiences, postsecondary education, and the world of work.

"There is an ongoing mismatch between what is being taught in our schools and the skills that employers need. The experience of education is simply not designed to match the experience of work."

—Jonathan Raymond, President, Corporation for Business, Work and Learning

Bridging the gap between the classroom, postsecondary education, and the workplace helps students better understand the real-world implications of their studies, heightening their interest in learning and their motivation to excel. Work-based learning experiences and other contextual teaching and learning strategies can also improve student mastery of abstract math and science concepts—enabling students to "learn by doing." Stronger connections with postsecondary education can enrich the high school curriculum, reduce the need for remediation when students enter college, and accelerate the completion of postsecondary degrees.

Challenges to Forming Learning Linkages for Youth

Unfortunately, too many schools continue to segregate academic and technical skill instruction and provide students with only limited opportunities to explore career options and participate in work-based learning activities. Some schools are reluctant to promote career exploration and career-oriented education, because they believe these practices discourage students from pursuing higher education.

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"The item of the presentation with the greatest impact to the students is when they see a real life budget, based on an introductory salary, and how quickly that is not enough to obtain the things in life that they want. Afterwards, students are challenged to think of where they want to go and how they are going to get there. We show them what they need for skills, whether they go directly into the workforce or on to college or trade schools."

—Keith Reimer, Vice President of Sales, Compuquik, describing how students are encouraged to enroll in challenging high school courses after understanding the economic consequences of poor educational preparation.

Improving the connections between school and the workplace in ways that enhance student learning can also be difficult to do well. Linking students with employers, particularly smaller, fast-paced companies in the IT industry, can be a formidable logistical challenge. Ensuring that work-based learning opportunities are meaningful and reinforce classroom instruction is also time-consuming for both school personnel and employers.

Strengthening linkages between high schools and postsecondary education is equally complex and time-consuming. It requires a careful analysis of the content of courses and how they can be better aligned among institutions to facilitate the awarding of dual credits. Sharing funds between public institutions which are, most likely, supervised by different divisions of state and local government, will also need to be addressed. Concern that eliminating duplicate programs and areas of instruction might cause either secondary or postsecondary institutions to lose personnel or other resources can sometimes be an additional impediment to improving the connections between secondary and postsecondary education.

Trends and Practices in Forming Learning Linkages for Youth

Despite these challenges, the Commission heard of a number of successful strategies designed to form stronger learning linkages for youth.

Student Motivation

- Educators and students who addressed the Commission generally debunked the notion that learning IT and workplace skills decreases students' interest in postsecondary education. Instead, they said that students who have successful

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work-based learning experiences with information technology grow more, not less, interested in pursuing postsecondary education.

Dual Enrollments/Credits

- Partnerships between schools and postsecondary institutions are aligning curricula, enrollment policies, and funding so that "average" students can gain college credits and concurrently fulfill high school graduation requirements. **The Chicago Public Schools' (CPS) partnership with DeVry Institute and New Hampshire Community Technical College's Running Start** partnerships with surrounding school districts are excellent examples of this trend.

Programs like the CPS/DeVry Partnership and Running Start have traditionally been available for high-achieving students, such as those enrolled in Advanced Placement (AP) courses. The Commission observed a growing trend toward making these programs more widely available to middle-achieving students. Providing dual enrollment opportunities can engage middle-achieving students in learning and motivate them to pursue postsecondary education. By enabling students to complete postsecondary programs more quickly, such programs can also help make college more affordable.

> *"Students had no idea what careers are available to them and, as a result, had given little thought to backgrounds they needed to achieve those career goals."*
>
> —Dr. Robert L. Caret, President, San Jose State University

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In-School Business Models

- Schools and businesses are forming partnerships that provide students with technical skills which are applied in an internship work experience. Some programs like **Youth Tech Entrepreneurs in Massachusetts[30] and Tech Crew programs in Mississippi[31]** teach students technology skills and employ these students to maintain and upgrade computer networks in schools and other local public institutions. Taxpayers also benefit because these in-school IT teams often reduce the cost of setting up and maintaining school system computer networks.

Certifications

Hundreds of high schools and postsecondary institutions are offering general and vendor-specific programs that lead to certifications for an array of high-demand skills. These programs include:

- **CompTIA's program** on computer repair and maintenance leading to the **A+ Certification.[32]**

- **The Cisco Academy** program for installing and maintaining Internet routers leading to the **Cisco Certified Network Administrator** (CCNA) certificate.[37]
- Training in use of computer applications leading to the **Microsoft Office User Specialist (MOUS)** certification.[38]

Carl D. Perkins Vocational and Technical Education Act

Many of the important reforms the Commission observed are supported by recent changes made to the Carl D. Perkins Vocational and Technical Education Act of 1998.

Traditional vocational education was designed to meet the skill needs of an industrial economy. To better meet the needs of America's emerging Information Economy, the new Perkins legislation refocuses the federal investment in vocational and technical education on programs that improve student acquisition of academic and technical skills and prepare students for postsecondary education, further learning, and careers.

"The idea is simple and the idea is scalable; programs that teach students to become computer teachers, technicians, and entrepreneurs help students succeed and provide much-need computer help to schools in the process."

—Michael Goldstein, Youth Tech Entrepreneurs

To achieve these goals, many school districts are restructuring their vocational and technical education programs to include:

- A college-prep level of math, science, and communication skills.
- A curriculum structured around broad career clusters, such as informationtechnology.
- A sequence of courses starting in high school that is linked to associate's and bachelor's degree programs in two- and four-year institutions, popularly known as tech-prep.
- Opportunities for high school students to take college level courses.
- Stronger partnerships between high schools, colleges, and industry that offer opportunities for internships and work-based learning opportunities.

In addition, the U.S. Department of Education is supporting a partnership between the states, the IT industry, and secondary and postsecondary schools to identify and develop IT standards, core curriculum, assessments, IT career information, and teacher training materials. This IT Building Linkages project expands work sponsored by the National Science Foundation and industry partners to create pathways for students to IT careers.

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Leadership Response to Forming Learning Linkages for Youth

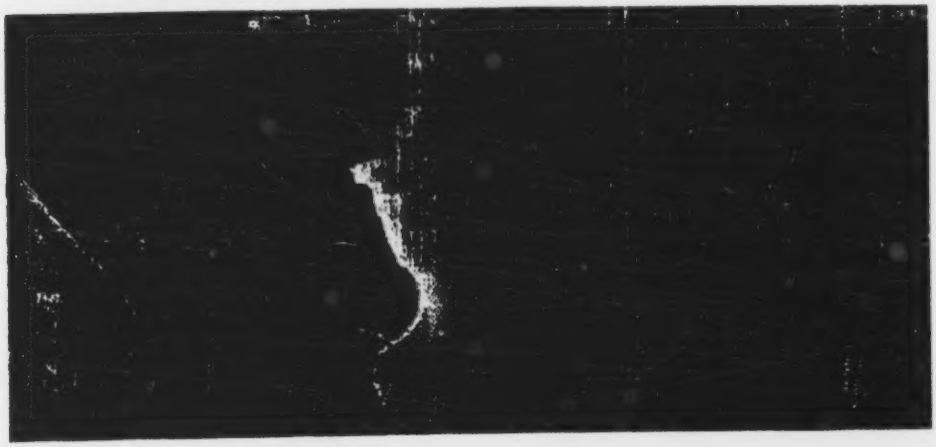
—High School and Postsecondary Education Linkages: School districts, postsecondary institutions, and state leaders should continue to expand and strengthen connections between high school and postsecondary education through AP classes, tech-prep, dual enrollment, and career academies, among other strategies. These initiatives must not only serve high-performing students, but also engage "average" students who may not be actively and realistically preparing themselves for postsecondary education.

—Work and Community-Based Experience: School districts, state education leaders, businesses, and youth councils created under the Workforce Investment Act (WIA) should collaborate to ensure that all students have the opportunity to participate in community-based work experiences that are linked to classroom instruction by the time they graduate from high school. These work experiences should be carefully developed with employers to help students gain academic and technical skills, as well as an appreciation and understanding of the world of work, the implications of economic trends on an organization, issues of organizational structure and finance, and effective management principles.

—Skills Certifications: High schools should broaden the array of courses that lead to either generic or vendor-specific technology competency certifications, focusing on skills that are in demand in the local or regional economies.

—In-School Business Models: High schools should create more programs that offer students the opportunity to develop hands-on technology skills, such as computer repair and networking, and to apply these skills at school and by working with local businesses.

—Career and Technical Education: Schools, school districts, and the business community, supported by improved federal programs, should work together to rapidly transform traditional vocational education programs into modern career and technical education programs that prepare students for postsecondary education and careers in high-technology fields. ■



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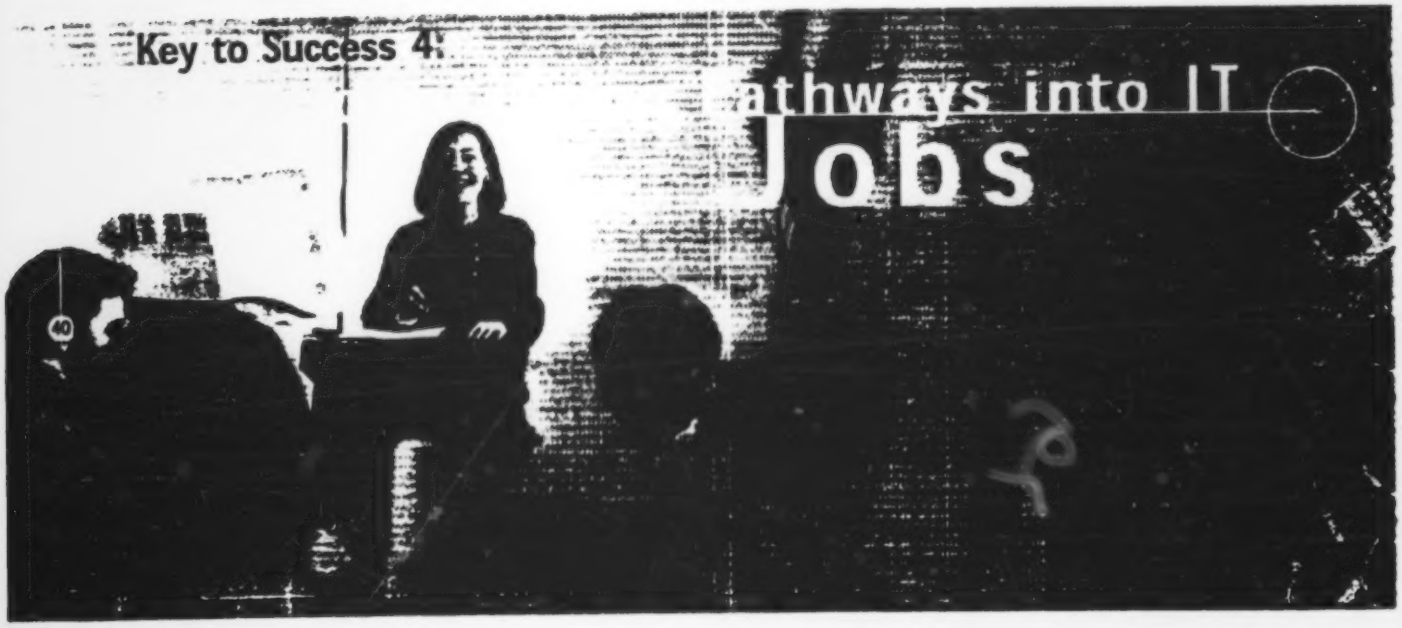
American adults and youth need to clearly understand the skills needed for IT employment at various levels and the opportunities for training.

There are promising opportunities in today's job market, particularly for IT jobs. There is also constant "churning" in the job market as traditional jobs disappear and new ones are created, largely in response to new technology applications.

In light of these opportunities and changes, the more Americans take charge of their careers and invest in lifelong learning, the better equipped they will be with the skills and knowledge required to stay competitive.



Relevance of Identifying Pathways into IT Jobs to Developing the IT Workforce

There is an urgent need for U.S. workers to be made aware of opportunities and pathways into IT occupations. One of the major obstacles to preparing for an IT career is a lack of knowledge regarding the skills required for IT jobs and how those skills can be acquired. To address this need, federal, state, and local agencies should form partnerships with businesses and non-profit organizations to increase public awareness of IT careers and their skill requirements. There are obvious advantages that could result from such a public awareness campaign — particularly for under-served populations.

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Career-Building Resources

In a large and diverse nation like the United States, there are youth and adults in many different places and circumstances who may be interested in joining the IT workforce, but they do not know how. Individuals exploring options within the IT job market want to know about specific opportunities within their immediate community, the surrounding region, and throughout the nation. Additionally, they need to know what skills, knowledge, aptitudes, and experience are required to perform different types of IT jobs. Finally, job seekers need to know the steps in education, training, and the job searching techniques required to secure an IT job.

Electronic databases and other career-building resources can help consumers (whether they are students, career changers, displaced workers, or incumbent workers needing a skills upgrade) make smart decisions about education and training related to information technology jobs. Most of these resources are available through the Internet. The challenge is to make potential users aware of them.

Workforce Investment Act Customers

Another pool of youth and adults who can benefit from clearly marked pathways into IT jobs are those individuals receiving job search, placement, and referral services through programs operated under the Workforce Investment Act. WIA set in motion a process for retooling the adult and youth training system that had previously been administered by Private Industry Councils under the 1982 Job Training Partnership Act.

"We need to foster a flexible education system — one that integrates work and training and that serves the needs of both experienced workers at different stages in their careers and of students embarking on their initial course of study."

—Alan Greenspan, Federal Reserve Board Chairman

Participants in Adult Education (Basic Skills) Programs

Adults who are currently working to strengthen their basic skills represent a large pool of potential IT workers. If these adults succeed and develop a strong foundation of basic skills, they can pursue further training to achieve measurable expertise in IT skills. For many IT jobs, two-year degrees and/or certifications, combined with strong basic and workplace skills, make a worker very competitive.

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Challenges to Identifying Pathways into IT Jobs

Low Visibility of Career-Building Resources

If a job seeker is not aware of available career-building resources, the existence of these services is irrelevant. Raising awareness about these resources is a critical challenge and should be an integral component of every local and regional IT workforce development strategy.

Quick Look Summary of Occupations

Emerging Occupation	Salary		Training		
	Beginning	Experienced	Deliverable	Avg. Time	Avg. Cost
Telecommunications Installer	$7-15 / hr	$15-22 / hr	Certificate AS Degree	9 months 2 years	$400 $720
Technical Writer (*)	$12-33 / hr	$20-65 / hr	Certificate	1 year	$200
Technical Support Rep.	$8-15 / hr	$12-34 / hr	AS Degree	2 years	$720
PC Technician	$8-18 / hr	$12-35 / hr	Certificate AS Degree	2 semesters 2 years	$300 $720
Network Administrator	$15-20 / hr	$18-35 / hr	AS Degree	2 years	$720
Network Technician (*)	$10-24 / hr	$11-35 / hr AS Degree	Certificate 2 years	1 year	$200 $720
Computer Programmer (*)	$12-31 / hr	$20-60 / hr	Certificate AS Degree	3 semesters 2 years	$250 $720
Web Designer (*)	$12-40 / hr	$25-115 / hr	Courses AS Degree s	4 month 2 years	$400 $720
Webmaster (*)	$10-20 / hr	$15-40 / hr	Certificate AS Degree	3-9 month 2 years	$300 $720

* high demand occupation

This chart was adapted from a career-planning workbook used in the San Francisco Bay Area. The entire workbook is designed for the prospective career changer and includes the following information about the eight job clusters covered: occupation overview; future growth opportunities; job descriptions; skills requirements; experience requirements; education/training required; Bay Area education/training resources available; employers who will be hiring; and recommended job search strategy. The career guide is aimed at short-term training only for jobs requiring an associate's degree or less.

Source: The Compass Group, "Information Technology Career Guide for the San Francisco Bay Area, Ride the Wave," Alameda Private Industry Council and the Center for Business and Education Partnerships, Chabot Las Positas, July 1999.

Other career-building resources may have high visibility but are not user-friendly or comprehensive. For example, some resources group IT jobs with widely varying salaries and required experience into the same category, forcing job seekers to sift through information that may not be relevant to their needs. While it is true that resources listing current IT employment opportunities are plentiful, these resources may offer little or no guidance to career changers who need to make major decisions regarding career direction and training.

Implementation of the Workforce Investment Act

Because success in implementing the Workforce Investment Act hinges on effective local leadership and programs, it is imperative that community leaders, particularly business leaders, be actively involved.

WIA required that business leaders be a majority of the membership of all state and local Workforce Investment Boards by June 1, 2000. However, a simple majority of business people on the Board does not guarantee that the WIA system will become closely aligned to local employer skill demands. If appointed business people are too busy to provide active leadership, or if the system does not aggressively reach out to evaluate local skills needs among employers and align its programs and practices to address those needs, traditional operations will continue.

Regardless of their direct participation in local Workforce Investment Boards, business leaders need to insist that the *status quo* not prevail. Active involvement of business leaders in the creation and implementation of workforce development policies will encourage these systems to become more flexible, customer-focused, and responsive to the skill needs of local economies.

"Each worker has to be increasingly aware of what skills and experiences he or she has that add value to the company. Individuals need to understand the changes in their industry, in other industries in the local and even global economy, in order to understand how to position themselves to earn premium wages."

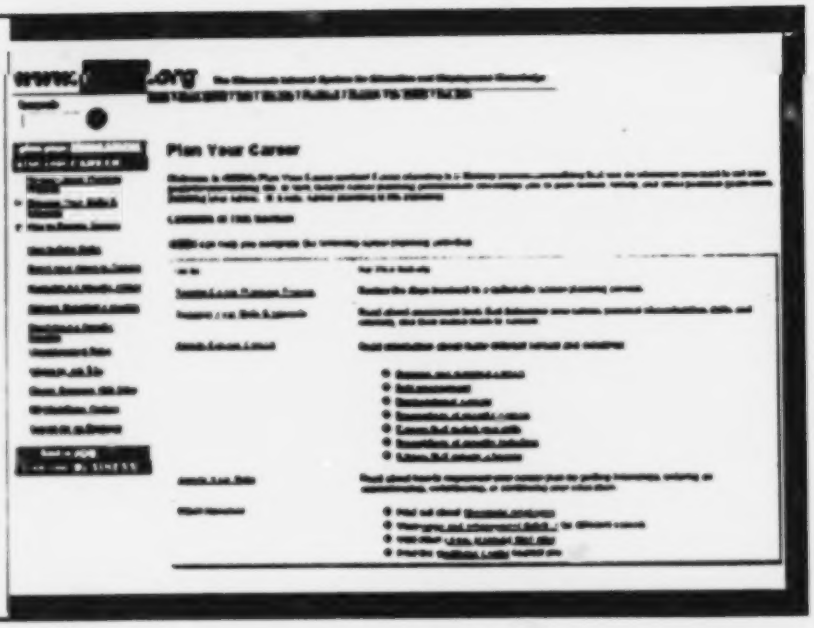
—Mike Curran, Director, NOVA Private Industry Council

Adult Education (Basic Skills) Programs

In addition, there are not enough formal linkages between adult basic education programs and entry-level IT skills programs. Linking these learning paths may present another promising opportunity to help adults forge a path into IT employment.

Welfare-to-work participants especially need to acquire 21st Century Literacy to quickly advance in their work experience. Getting that first real job and keeping it is an important step for an individual who has been welfare dependent. But without strong, marketable skills, the individual will merely change status from "unemployed poor" to "working poor."

ISEEK—the Internet System for Education and Employment Knowledge—was created to help individuals make choices about careers, employment, education, and training. It does this by providing information in four main areas: career planning, education and training, job search and business growth. The ISEEK organization is a consortium of several Minnesota state agencies, education partners, and private organizations.



Trends and Practices in Identifying Pathways into IT Jobs

Career-Building Resources

There are many resources available to the job seeker and career changer which, when well-conceived and executed, can help workers and job seekers make wise decisions about education and training options.

- Most local community colleges have career information centers that offer an array of services: counseling, workshops, printed materials and access to electronic job banks.
- Under WIA, each local One-Stop Career Center is required to provide career counseling and access to web-based job banks. Most One-Stops also offer many other support services to eligible participants.
- Many other career-building resources exist, such as those sponsored by individual companies, industry associations, labor unions, and public-private partnerships. More are emerging every week.

Technology Skills for Welfare-to-Work Participants

The Commission learned about pilot programs in Dallas (Access2000™) and San Francisco (Clickstart.org) that help welfare-to-work participants become fluent in technology by providing them with technology training and a computer to use at home. Should initiatives like those in Dallas and San Francisco become more widespread, they may provide additional opportunities for program participants to engage in specific IT skills training and secure higher paying IT employment.

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Program Linkages and Flexibility

Legislation, such as the 1996 Personal Responsibility and Work Opportunity Reconciliation Act (better known as the 1996 Welfare Reform Act), the Workforce Investment Act, and the Carl D. Perkins Vocational and Technical Education Act, as amended, allows states and localities more flexibility in allocating funding available for education and workforce development than in the past. The key now is to promote that flexibility. This requires clear guidance from the federal government to the States and local partnerships on how funding can be creatively applied to address the Information Economy's workforce and education challenges.

"Entry ramp programs have to be tailored to the needs of learners, not the convenience of the trainers."

—Jonathan Raymond, President, Corporation for Business, Work and Learning

Leadership Response to Identifying Pathways into IT Jobs

— Offer Career-Building and Navigation Tools: Business organizations, community colleges, local Workforce Investment Boards through One-Stop Career Centers, labor unions, and other entities should develop and make available sophisticated "career-building" resources. These resources will enable individuals to conduct personal skills assessments, examine possible career matches, and choose courses of study and training that will help them get quality jobs.

— Business Leadership: Businesses should be active local leaders in establishing programs and policies that will result in an increased supply of highly skilled workers ready for today's IT jobs.

— Pathways from Basic Skills to IT Skills: Local welfare-to-work programs, Workforce Investment Boards, adult education programs, and community colleges need to create linkages that provide clear, sequential skills-building pathways for adults making transitions from basic skills and workplace training into job-specific IT skills training programs.

— Workforce Investment Act: State and local Workforce Investment Boards, supported by the U.S. Department of Labor, should insist that, as the Workforce Investment Act is implemented, local workforce development services are flexible, responsive to occupations in demand, and provide seamless, customer-friendly services through One-Stop Career Centers. To ensure the full development of One-Stop Career Centers, Congress and the Executive Branch should provide adequate funding for the administrative costs and the federal services that are provided within the centers.

— Linkages among Federal Programs: Federal, state, and local governments should provide technical assistance to businesses on how welfare-to-work, adult education funds, and state funds made available by the Workforce Investment Act, can be used by companies to provide their employees with basic skills and IT skills training. ■

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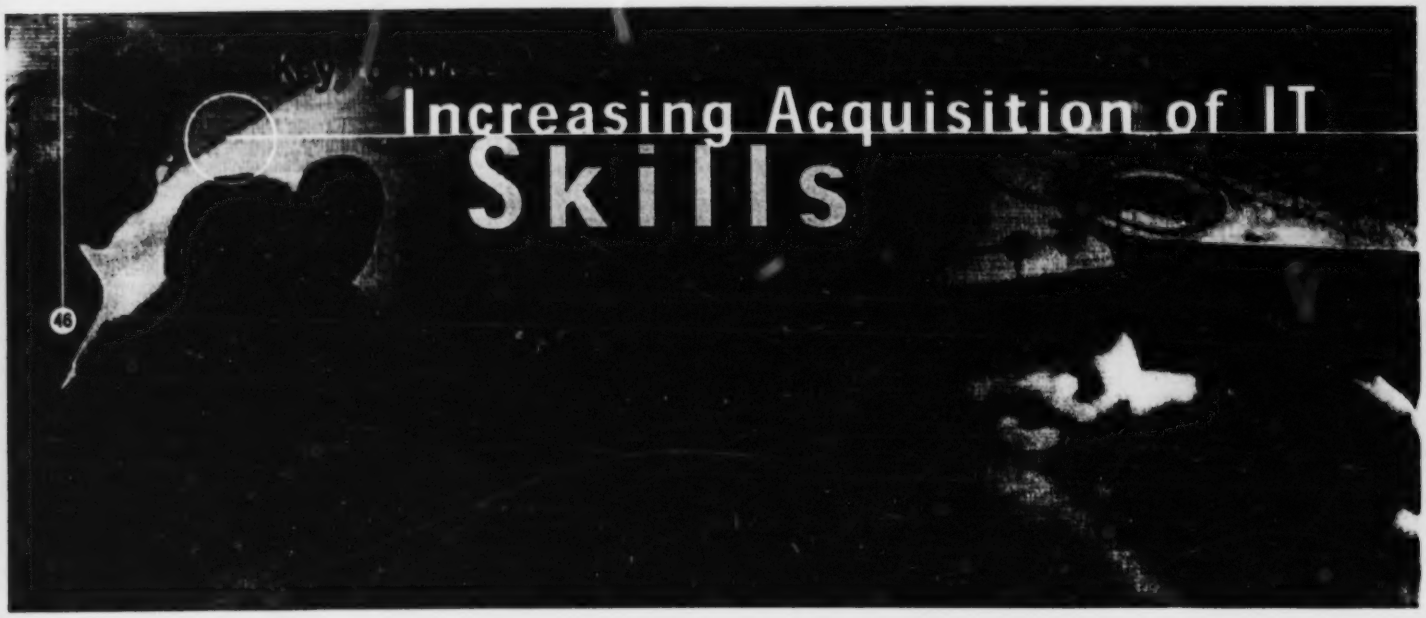
More Americans need to enroll in and complete high-quality information technology programs that provide them with up-to-date skills and knowledge needed to succeed in today's IT workplace.

With an estimated 200,000 job openings every year in the Core IT Professions, it is clear that the number of students currently projected to graduate from America's engineering and computer science programs will not be sufficient to meet this nation's demand for new IT workers.

According to the U.S. Department of Commerce, about 75 percent, or 150,000, of the new jobs among the Core IT Professions projected to be available every



year require a four-year degree. Another 50,000 of these new jobs will require a two-year degree.[28]

As the number of students enrolling in postsecondary education substantially increases in the future, one solution to the IT workforce challenge will most certainly be to ensure that more postsecondary students enroll in and complete IT-related degrees or certificates.

As noted in the previous section, there are many pathways by which individuals enter the IT field. Many liberal arts majors with solid "21st Century Literacy," and some technical experience have advanced in the IT field through on-the-job training and continuous education. Alternative programs are another solution to the IT skills gap.

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Thus, IT education and training programs of varying lengths can be used to fulfill the need to increase enrollment by non-traditional sources of IT workers, such as underrepresented minorities, college graduates with non-technical degrees, older engineers needing upgraded IT skills, and workers seeking a career change.

Relevance of Increasing Acquisition of IT Skills to Developing the IT Workforce

Examining the education profile of today's IT workforce reveals the high level of technical skills and education needed for technology jobs. Two-thirds of all workers in highly skilled IT occupations hold a bachelor's or more advanced degree. Of those with a bachelor's degree, 46 percent have specific degrees, minors or second majors in computer science or computer engineering.[47]

Leaders of community colleges, proprietary training institutions, and IT vendor certification programs have rallied to meet the demand, offering programs in which individuals can enroll and become qualified for technician and support-level IT jobs. For example, in 1999, Microsoft reportedly trained 1.2 million people around the world through 1,900 commercial training companies and 900 U.S. academic institutions.[47]

"We have a real opportunity to also take these pools of potential and turn them into oceans of opportunity. Then we can truly say that this is an economy where we have broadly shared prosperity and we are, in fact, leaving no one behind."

—Alexis Herman, Secretary of Labor

Even with the progress being made, postsecondary institutions face a variety of challenges in responding to the needs of the IT industry.

Challenges to Increasing Acquisition of IT Skills

Three challenges face postsecondary programs providing IT skills and training:

- Continuing to increase overall enrollments to meet the projected need for two million new IT workers by 2008.
- Ensuring that women, minorities, and individuals with disabilities are proportionately represented in IT training programs.
- Increasing the relevance of IT education and training programs to the world of work.

Increasing Overall Enrollments

In coming decades, America's population will increase steadily, and the percentage of the population completing postsecondary education will also increase. In 1997, about 67 percent of high school graduates enrolled in postsecondary education. By 2010, the number of adults with some college experience is expected to reach 75 percent.[39] Approximately 14.9 million persons were enrolled in postsecondary education in 1999. The number is projected to increase to more than 16 million by 2009 — an increase of more than seven percent.[40]

After a 40 percent drop in bachelor's degrees awarded in computer science between 1986 and 1994, bachelor-level enrollments in leading U.S. computer science and computer engineering programs have more than doubled in the past three years.[41]

Should the popularity of computer science and related degree programs continue to increase, the traditional "bricks and mortar" capacity of individual postsecondary institutions to meet the demand could be strained, forcing leaders in government, industry, and education to ask: "What is the overall capacity of the system to educate large numbers of adults and youth for the IT workforce, and how can we best increase that capacity?"

Underrepresented Groups

White males continue to dominate information technology fields. Women and some minorities, notably African-Americans and Hispanics, are significantly underrepresented in the field. This presents both a challenge and an opportunity to increase the size of the IT workforce.

In the United States, women represent approximately 30 percent of IT professionals, although they make up about 51 percent of the population.[42] In the United States, the technology gap between women and men appears to be largely a cultural phenomenon. In India, for example, the ratio of women entering the IT professions is 41 percent and, in some companies, the ratio of women to men is 50/50.[43]

Data indicates that Blacks and Hispanics are likewise underrepresented in the Core IT Professions.[44] Blacks earned fewer than eight percent of IT bachelor's degrees, but represented nearly 12 percent of the population. Hispanics earned almost six percent of IT bachelor's degrees, but make up more than ten percent of the population. Conversely, Asians earned 11 percent of bachelor's degrees in IT programs, but represent approximately three percent of the general population.[45] However, it should be noted that a higher percentage of Blacks and Hispanics who graduate from college earn their degrees in computer science and engineering than white graduates.

An additional, but often untapped, pool of workers includes individuals with disabilities. As enabling technologies become more sophisticated and more commonly available, more individuals with disabilities will be able to perform IT jobs.

"Once a student reaches college age, people seem to feel that it is up to the student to take responsibility for his or her own life. If a student drops out of college, the assumption is that the student was not sufficiently motivated. In effect, when it comes to college, the public blames the problems on the consumer, rather than on the producer."

—John Immerwahr, Senior Research Fellow at Public Agenda

Making IT Curriculum Relevant

A serious challenge facing postsecondary educational institutions is the degree to which their technology curriculum and programs are relevant to IT employers.

- Four-year institutions have been criticized for placing more emphasis on theory and research than on helping IT students develop skills in problem solving for the real world and mastering state-of-the-art programming and networking skills. Another challenge facing four-year institutions is the extended period, sometimes as long as two years, that is required to gain approval for significant program and curriculum changes from within institutions and by state governing bodies.
- Some two-year colleges offer a small selection of IT programs that focus on teacher computer applications, but have not developed comprehensive IT programs. Throughout its tenure, the Commission learned about successful community colleges reaching out to industry, developing customized programs that respond to local needs, and adjusting those programs over time. These successful community colleges can serve as models for other postsecondary institutions to improve their programs so they are responsive to employer needs and offer a comprehensive array of skills relevant to today's workplace.
- Completion of Skills-based Programs. In advocating higher completion rates from IT training programs, the Commission is not suggesting that meeting a "seat time" requirement provides adequate preparation for successful IT employment. Employers want to hire individuals who have mastered specific IT skills. This has been the major driving force behind the phenomenal growth of industry certifications. Four-year degrees are still in high demand, but employers also want to know that IT degreed programs are closely aligned to knowledge and skills required in the workplace.

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Employers' Demand for Academic and "Soft Skills"

Surveys by industry associations, supported by statistical data on IT hiring practices, demonstrate that IT employers prefer workers who hold a four-year degree. [49] For many jobs, certifications of mastery in specific technologies may provide an additional market edge, but the four-year degree remains a desired credential for hiring.

The Commission did not find any direct evidence to support the prevalence of this standard practice. Some hiring managers who posted job listings requiring a four-year degree could not clearly explain the reasoning behind the company policy.

Research by Richard J. Murnane and Frank Levy in the book "Teaching the New Basic Skills"[50] indicates that, in the business community, a bachelor's degree is often seen as a "proxy" for a set of advanced academic skills, a strong work ethic, and general analytical and teamwork skills required in the workplace. The research further indicates that the skills needed by most employers are essentially the skills that a well-educated high school graduate should possess. They concluded that because most high school diplomas do not signal competencies and acquired skills and knowledge, employers have defaulted to acknowledging a baccalaureate degree as the preferred credential.

IT company leaders told the Commission that they highly valued employees who had a broad set of "soft" skills — communication, problem solving, and the ability to engage in continuous learning. Some employers even noted that they would prefer to simply hire "smart" people without any existing IT credentials and provide them all the technical training needed to perform a job.

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Apparently, in the IT labor market, as well as in other sectors, a four-year degree serves as a "proxy" for a broad mix of knowledge and talents — beyond just technical skills — that employers value.

Towards this end, the Chauncey Group International[51], in collaboration with **Northwest Center for Emerging Technologies (NWCET)**, has developed a certification program that is aligned with the IT skills standards identified by NWCET. **The Associate Technology Specialist (ATS)** certification program is broken up into eight career clusters. The Chauncey Group integrates within each of its clusters "core skills" to measure a student's acquisition of "soft" skills that employers have identified as necessary for employment.

"It is clear from our experiences in Boston that the speed of educational institutions developing programs must match the speed at which employers are evolving and demanding new employee development programs."

—Leon Zaborowski, Vice Provost for Adult and Continuing Education, Northeastern University

"It is evident that this level of training (short-term) is not always enough for employers in the high-tech community. The six-week or six-month training programs or certifications can successfully teach 'hard' skills, but they fail to give their graduates the essential analytical skills to solve many of the complex technical challenges that they will encounter in the workplace."

—Susan Baker, Northern Virginia Technology Council

It will be worth observing if certifications that measure soft skills mastery and reforms that increase the perceived value of a high school diploma will one day reduce employers' reliance on the four-year degree as the credential of choice for most IT jobs.

Trends and Practices in Increasing Acquisition of IT Skills

The Commission learned of numerous innovative approaches to increasing the acquisition of IT skills at the local level.

- The Massachusetts Software and Internet Council worked with industry and education groups to develop a 23-week IT training program that targets people who have been laid off from other industries, who are leaving the military, or who are interested in changing careers. The average participant is between 40 and 50 years old, and the program has an extremely high placement rate.[48]
- Internships: The Commission also discovered examples in which postsecondary institutions and businesses have developed internship programs. Internships, like the Hewlett-Packard Diversity in Education Initiative, that occur earlier in the student's academic career can provide real-world experience and a valuable support system that can help the student weather the storms of adjusting to a difficult technical curriculum.[49] For the school, internships present an excellent opportunity to increase student retention and give students "real-world" work experience in tandem with their academic training. For businesses, internships are a wise investment, providing talented labor and often streamlining the recruiting process.
- Early Technical Content: Some postsecondary institutions, such as the DeVry Institutes, introduce technical courses during the freshman year to allow students to gain marketable technical skills, in addition to general education requirements.[50] For students struggling financially to attend school on a full-time basis, gaining technical skills can allow them to earn significant income while they work toward completion of the program.

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Individuals with Disabilities

The Commission learned about promising initiatives to foster long-term relationships between students with disabilities and IT companies. The participating businesses provide internships and ongoing educational support to help students enroll in and successfully complete demanding IT postsecondary educational programs. It is not unusual for sponsoring companies to hire interns after they graduate.

Employee Advisory Boards

A number of institutions have implemented employer advisory boards to make sure that their curriculums are relevant and current and that their students are gaining a wide range of technical and non-technical skills needed for workplace success.

Industry-developed Skills Standards

Postsecondary institutions are also drawing upon industry-developed skills standards to ensure that the IT curriculums they offer are broad enough to address the full complement of knowledge and skills students need.

Creation of Comprehensive IT Programs

A growing number of community colleges have developed exemplary and comprehensive IT training programs as part of **Working Connections,** a national initiative supported by **Microsoft Corporation** and the **American Association of Community Colleges.**[51] This initiative is working to expand the availability of comprehensive IT programs among community colleges.

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The Commission urges leaders in education and business to share the common goal of closely aligning high-quality IT certification and degree programs with skills demanded in the workplace.

Expanding the Capacity of Education and Training

Fortunately, capacity for postsecondary learning is growing through various means.

- The private market of vendors offering short-term training and for-profit companies using distance learning is increasing the capacity to reach students and making program schedules more flexible.
- Many public institutions are likewise developing distance learning programs that can be accessed anytime, anywhere, as well as "executive" programs that meet on weeknights and weekends to accommodate working adults.
- Postsecondary institutions are developing shorter-term technology degrees, so-called "capstone degrees," that help students who already hold a four-year degree in the liberal arts earn a technology degree on an accelerated basis.
- IT Skills to Accompany Liberal Arts Degrees. Some business and policy leaders endorse the approach taken by the University of Minnesota: offering

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a minor in information technology within the College of Liberal Arts, thus enhancing the employment options of its graduates.[52]

- A technology executive/philanthropist has announced plans to develop a university-level distance learning program that would be available at no cost to the enrollee.[53]

Alternative learning resources are continually expanding and will provide significant opportunities for Americans to gain new skills and knowledge while balancing work and family responsibilities.

Leadership Response to Increasing Acquisition of IT Skills

— Internships and Mentoring: Schools and businesses should create internship and mentoring programs for postsecondary students to begin during the freshman year paying special attention to the needs of underrepresented groups.

— Student Support Services: Postsecondary institutions should provide adequate student support services to help students develop effective study and time management habits to succeed academically and complete rigorous IT training programs.

— Enriched Curriculum: Postsecondary institutions should consider introducing the technology components of a curriculum as early as the student's first semester.

— Expanded Capacity for Education and Training: Postsecondary institutions need to expand the number and types of education and training programs available. They should tailor them to student needs using innovative delivery methods — especially the use of distance learning and emerging technologies.

— Curriculum Aligned with IT Skills: Schools need to consult with business advisory boards and review industry-based skills standards on a regular basis to ensure the IT and business curricula are relevant, up-to-date, and provide students with in-demand skills. ■

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"Although 50 percent of our students have come from economically at-risk circumstances, TexPREP has proved that under the guidance of competent and caring teachers, these students can acquire the necessary quality educational preparation to succeed in college."

—Manuel P. Berriozabal, The University of Texas at San Antonio, Coordinator of TexPREP program.

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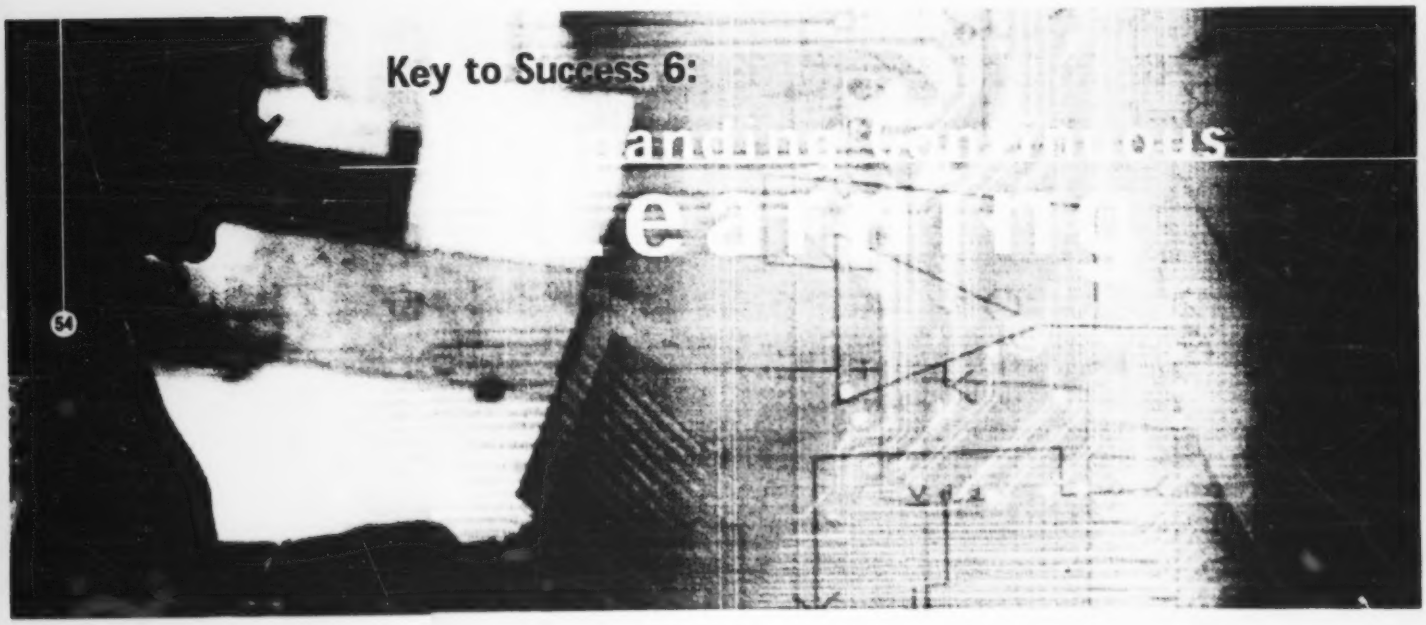
Americans in the 21st Century workplace will need to continuously upgrade their skills and knowledge as new technologies and work patterns emerge.

Life is no longer segmented into hours or years allocated for school and work. Those distinctions are now blurred — schooling continues in the workplace and beyond. To accommodate this phenomenon, schools and corporations are increasingly challenged to shorten and sharpen the learning cycle.

The Commission for a Nation of Lifelong Learners found that the future of our country is tied to the need for continuous learning across all levels and all groups of people.[54] Most adults — more than 80 percent — believe they need more education to advance their careers. And, even more importantly, workers now understand that it is their responsibility to get this additional training.



Relevance of Expanding Continuous Learning to Developing the IT Workforce

Today's complex economy does not call for IT workers who are "trained" in one set of skills. Rather, workers must be constantly engaged in learning, upgrading their skills, and making career decisions. For several years, many commissions and studies have heralded the advent of continuous or lifelong learning. In many regions of the country, the maturing of distance learning technologies, along with flexible course structures and delivery methods, fueled by industry and employee demand, have advanced continuous learning from concept to reality.

For example, every year in the **Silicon Valley** of California, institutions such as **Foothill and DeAnza Colleges[55], San Jose State University Continuing**

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The mobility and resourcefulness of the American worker is remarkable and has saved us from very severe social problems.

- Peter Drucker

Education Program," and University of California Extension, Santa Cruz,[57] provide short-term training to thousands of adults working in the region's IT industry. The IT industry and the continuing education/extension arms of postsecondary institutions in the region collaborate closely to make relevant skill-building courses broadly available. Continuous learning is firmly embedded in the business culture of Silicon Valley. It is a key to the region's competitiveness.

There is a plethora of resources that will provide workers with the skill sets required for a company to remain competitive in the marketplace. Therefore, it behooves business leaders to make regular and thorough analysis of their employee skills and training options and establish a strategy to develop an internal culture in which every worker becomes a lifelong learner.

Challenges to Expanding Continuous Learning

When workers and employers assess the need for more education and training, one of the first questions to surface is whether education is affordable. According to Public Agenda, a public policy opinion research firm, "access is the public's single biggest worry about higher education." [58]

Many witnesses appearing before the Commission expressed concern that existing funding resources are still geared to a traditional postsecondary experience and are not particularly relevant to short-term skills training required for continuous learning.

Traditional Loans and Grants Not Relevant

Traditional student loans and grants require the participant to be enrolled in a degree-seeking program, essentially eliminating federal student aid for short-term programs leading to certifications. Lifelong Learning Tax Credits offer the individual some relief for costs incurred in post-baccalaureate skills training, but like all tax relief, a significant up-front cash investment is required by the taxpayer.

Small Businesses Have Difficulty Providing Training

Not all firms are likely to provide equal education and training opportunities to their workforce.[59] The Commission learned that small and medium-sized businesses find it difficult to pay for employee skills training or to collaborate with local and/or region-

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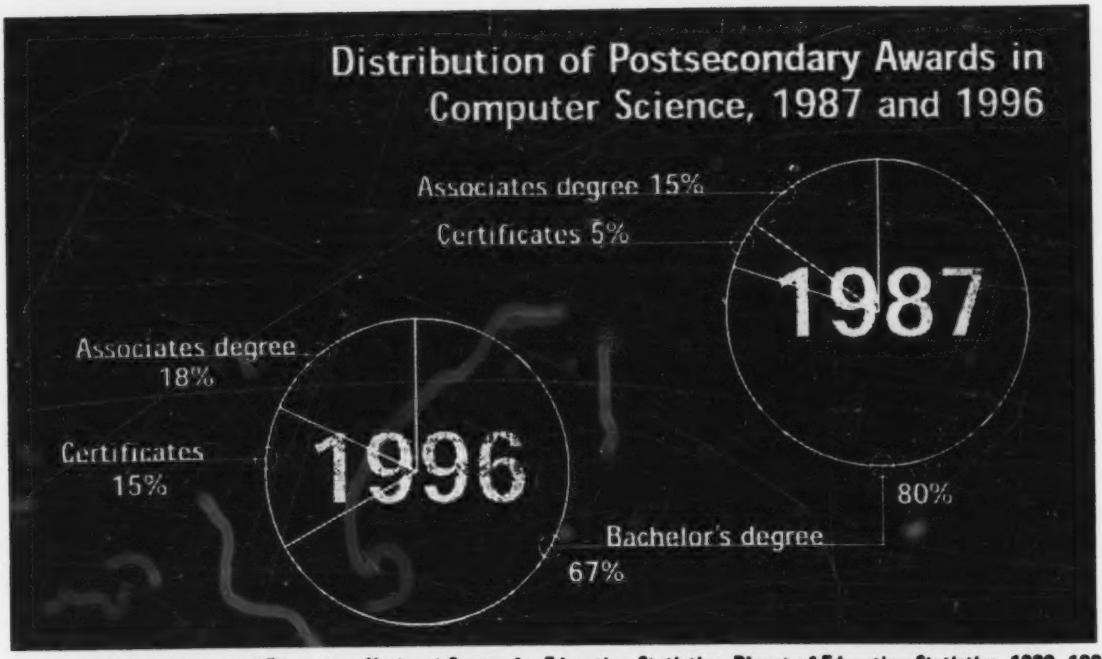

Source: U.S. Department of Education, National Center for Education Statistics, Digest of Education Statistics, 1989, 1998

al workforce development initiatives. Small and/or fast-growing companies often do not have the financial resources or cannot devote staff time to operating internal training programs.

Unemployment Benefits/Income Assistance

Another issue raised before the Commission is that, under certain state unemployment insurance (UI) systems, unemployment benefits lapse when an individual enters an education or skills training program that is not on the state-approved list that allows for continuing UI benefits.[60] If the program is approved by the state, the individual can continue to receive UI benefits. However, in some cases, the benefits are exhausted before the individual completes a training program. While any discussion of the length and use of unemployment benefits raises complicated questions, it appears counter-intuitive that an individual seeking to strengthen marketable skills should lose these benefits.

Incumbent Worker Training

In today's economy, IT training and skills development for incumbent workers are no longer rare or infrequent events, but are an ongoing requirement for every company to remain competitive.

A common concern among witnesses at the Commission hearings was that many existing education and training programs were developed based on an "unemployment model" rather than on a flexible model that is responsive to skills shortages. That is, training programs were primarily designed to assist individuals who had been laid off from "Old Economy" jobs. As a consequence, these programs have not traditionally provided skills development for "incumbent workers."

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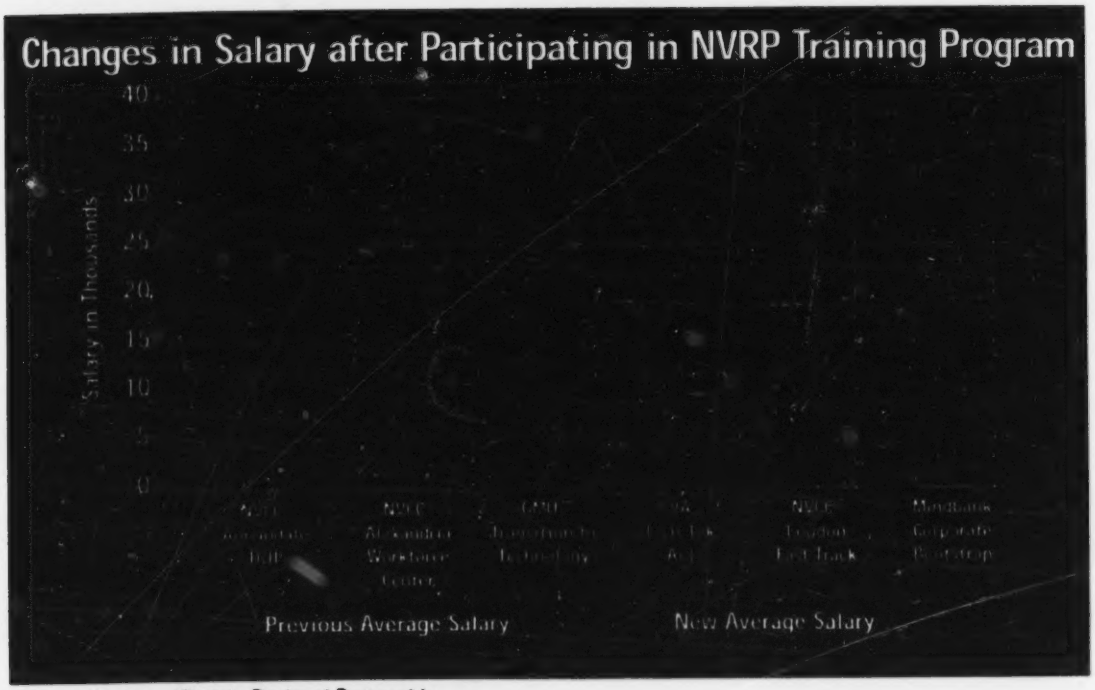
Trends and Practices in Expanding Continuous Learning

- Joint Venture: Silicon Valley Network, a business-led, non-profit organization, worked with several postsecondary institutions in the region to develop a strategic approach to high-tech education and continuous learning. New courses of varying lengths using multiple modes of delivery were developed and marketed to adult career changers and IT professionals who require continuing education.[41]
- The Northern Virginia Regional Partnership (NVRP), a regional partnership that receives state funding, worked with local IT organizations, educational organizations, and economic development agencies to conduct a regional assessment of the demand for IT skills.[42] Using conclusions from that assessment, the partnership and local postsecondary institutions developed short-term training programs to address IT skills shortages. Because short-term programs do not qualify for typical student aid funding, NVRP worked with the student loan funding organization, Sallie Mae, to create a low-interest loan program geared toward career-changing adults seeking to gain IT skills in short-term programs.



Source: Northern Virginia Regional Partnership

- Employer Provided Training. Every year, American business and industry allocate tens of billions of dollars toward formal training of workers. According to one industry publication, business investment in education and training rose by more than 33 percent between 1990 and 1998, from $45.5 billion to $62.5 billion.[43]

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- Basic Skills and Competencies. A small portion of this investment, from one to two percent, is used for basic skills training. Other training is provided to enhance and build competencies needed on the job.
- IT Skills Training. According to the American Society for Training and Development (ASTD), from 11 to 13 percent of training expenditures are allocated to training in information technology skills.[64] This would also include the training of non-IT staff to use enabling technology.
- IT Employees Trained. ASTD's data also indicates that the highest level of training expenditures among employee groups is allocated to IT staff. Professionals with IT responsibilities are the focus of about 25 percent of all training funds, compared to the next closest group of employees (17 percent of training expenditures).[65]

"Individuals workers must "own the process" of their own educational and training development (empowerment) and be convinced of the value of lifelong learning for their personal and career growth."

- Marshall Goldberg, Executive Director, Association of Joint Labor/Management Educational Programs

- Training Disparity. Labor unions indicate that a disproportionate level of training is allocated to management-level employees, rather than mid- and lower-level workers in an organization. The unions argue that a stronger investment in "front-line" workers would increase productivity and company performance.
- Increase Retention of Staff. The Commission heard from many employers that continuous learning is a critical part of their business plan and an important tool for keeping good employees. For example, Qualcomm, a San Diego-based company that offers digital wireless communications products and services, makes hundreds of on-line technical and general business process courses available at no charge to its employees.[66]

In contrast to the common fear that employees who acquire new skills will jump ship to the highest bidder, several employers, such as the Markem Corporation in New Hampshire, told the Commission that workers grow more loyal to a company that invests in their skills. Moreover, a company that invests in its employees is also likely to foster a culture responsive to employee needs and to create a positive work environment.

- An IT skills training tax credit could make it easier for businesses, especially small- and medium-sized ones, to invest in their employees' skills development and to devote resources to collaborative efforts toward workforce skills development. The State of Arizona is the first state to enact such a tax credit.[67]
- A related issue is Section 127 of the federal tax code, which allows for employer-provided educational tuition assistance to be exempt from

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taxation. Without this exemption, tuition assistance provided by the employer would be counted as taxable income to the employee. Additionally, the employer would have to count the tuition assistance in making payroll deductions for that employee. The existence of this tax provision appears to favorably affect training decisions, particularly for low- and mid-level workers, yet this provision is temporary.

- Incumbent Worker Training Flexibility. To allow for more flexibility in state continuous learning and IT training initiatives, the Workforce Investment Act allows the States to retain up to 15 percent of their funding for state-level activities. Among the many activities allowable for these funds is "incumbent" worker retraining.
  - Excellent examples of incumbent retraining are the partnerships emerging between labor unions and employers. These partnership programs offer short-term retraining to employees whose skill sets are, or will soon be, obsolete. Such efforts can have a particularly beneficial impact upon middle-aged and older-workers, enabling them to remain competitive in a rapidly changing marketplace.

"We see that the true power of these Internet technologies in education may lie not only in distance and asynchronous learning, but also in their ability to foster hybrid models of interactive learning involving in-class, online, faculty-driven, student-driven, synchronous, and asynchronous options."

- Mark David Milliron, President and CEO, League for Innovation in the Community College

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Leadership Response to Expanding Continuous Learning

— Availability of Relevant Courses: **Businesses, industry, educational institutions, and labor unions should work together to make sure that local or distance-learning programs address emerging skills needed by IT workers.**

— Policies Affecting Employer-provided Training: **Businesses should evaluate workers skills, available resources, and the impact of tax policies to develop clear company strategies to enhance worker skills and knowledge.**

— IT Training Tax Credit: **Congress and the States should create IT job-training tax credits to provide businesses with a partial credit for the costs of providing their workers with IT skills, for adult education that is linked to IT training, or for costs of engaging in partnerships related to IT skills training.**

— Unemployment Benefits and Job Training: **Congress, the Executive Branch, and the States should evaluate the need to provide income maintenance benefits to workers in training programs that are not on state-approved lists or to workers who have exhausted unemployment insurance benefits.**

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— Federal Funding for Continuous Learning: Congress and the Executive Branch need to carefully examine the full mix of loans, grants, tax exemptions, Lifelong Learning tax credits, and other funding resources to ensure that they are relevant and flexible enough to address the needs of workers engaging in continuous learning, and to help employers provide short-term training for employees. New approaches may be needed to assist individuals who want to invest in themselves by acquiring marketable skills.

— Tax Treatment of Employer-Provided Education: Congress should permanently extend Section 127 of the IRS code, making employer-provided educational assistance tax-free to both the employee and the employer.

— H-1B Fees for IT Training: Congress should continue to allocate H-1B fees to fund IT skills training programs.

— Flexibility for Incumbent Retraining: States should ensure that federal and state funds can be accessed by companies to retrain incumbent workers to fill new jobs being created. States should give clear guidance to businesses on how to access and use those funds. ■

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American immigration policy needs to be flexible to address ongoing IT skills shortages.

While it is difficult to determine the precise scope of the IT skills shortage in America, it is clear that there is a major disconnect between the skills and knowledge many Americans possess and the IT skills required by a large number of U.S. companies with high-tech job openings. The shortage of skilled IT workers in the United States is similar to shortages faced in other industrialized countries, including Ireland and Germany.[65]

Relevance of Shaping a Flexible Immigration Policy to Developing the IT Workforce

The availability of workers with high-tech skills is critical for a wide spectrum of industries ranging from computer software to bio-technology. During Commission

hearings, the role of the H-1B program in ensuring the availability of such workers was a recurring topic. The H-1B program allows employers to bring immigrant workers into the United States to fill jobs requiring specific skills and education (not confined to IT skills). Many business and economic development leaders testified about critical shortages of available workers with IT skills. They advocated for increased immigration through the H-1B program as a relevant strategy for addressing part of that shortfall. In response to these requests, Congress increased the number of allowed visas from 65,000 to 115,000 in 2000.

Challenges to Shaping a Flexible Immigration Policy

The IT skills gap largely reflects the growth and transformation of the United States from an industrial to an information services-based economy that requires more technical skills of its labor force. However, if American businesses are not able to fill

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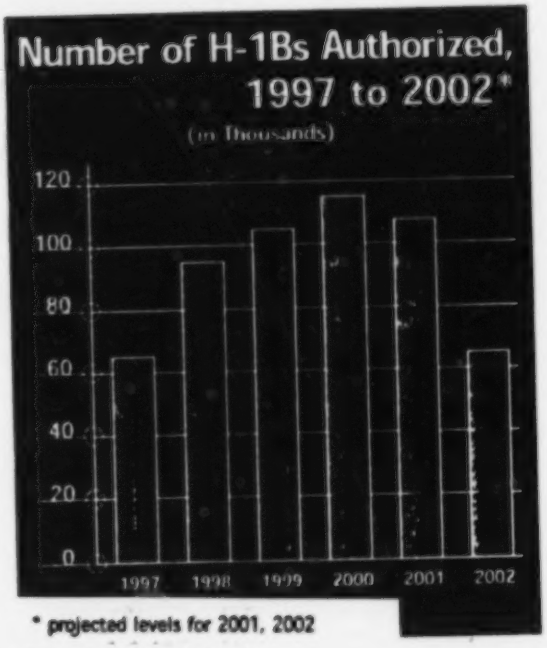
positions requiring highly skilled professionals — especially IT professionals — they may lose their competitive advantage, and jobs may be permanently exported to other countries with available, skilled workers.

Trends and Practices in Shaping a Flexible Immigration Policy

There are a number of pending legislative actions that would address the IT skills shortage issue. Among them are proposals that would:

- Temporarily raise the number of H-1B visas above the current 115,000 cap.
- Exclude from the H-1B visa cap foreign-born workers employed by universities and those with advanced degrees.

- Require the Immigration and Naturalization Service to give priority for processing H-1B petitions on behalf of students graduating from U.S. universities with advanced technical degrees.
- Create a new immigration visa category (The "T" Visa) for foreign-born technology professionals.
- Allocate fees from H-1B visas to various education initiatives, such as providing loan forgiveness for math, science and engineering teachers; expanding math, science, and technology outreach programs to disadvantaged youth; and, developing improved approaches to math, science, and engineering education.



* projected levels for 2001, 2002

Source: Tech Law Journal

Leadership Response to Shaping a Flexible Immigration Policy

— Raise Caps: Congress should raise the caps for H-1B visas in response to skills shortages and regularly modify those caps in accordance with economic and job demand trends.

— Increase H-1B Employer Fees: Any significant increases in H-1B visas should be accompanied by an increase in the employer fee for H-1B petitions (the current fee is $500.) This increase in employer fees will increase the number of U.S. workers who are trained for information technology jobs. ■

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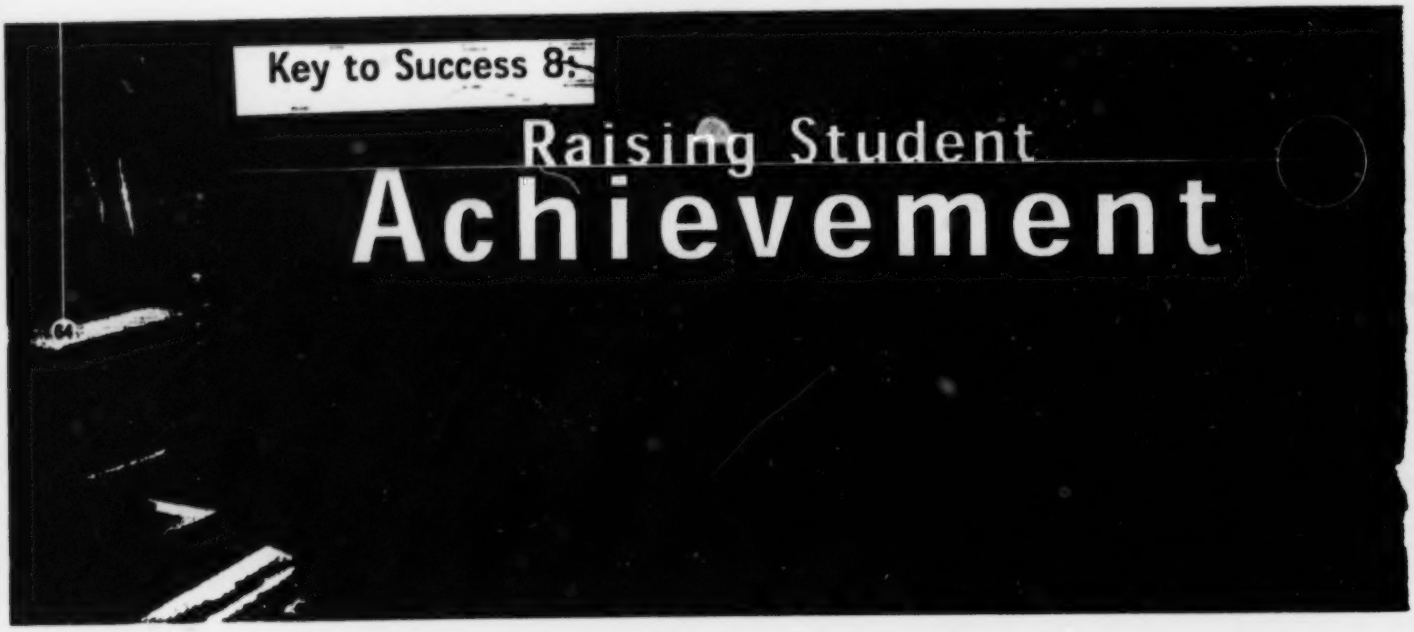
American schools need to make sustained and continuous improvements so that students are prepared for postsecondary learning and 21st Century jobs.

The common rallying cry among business leaders is that they need workers who can read with comprehension, communicate clearly, compute with numbers, think critically, process new information, and remain ready and eager to learn throughout their careers.

As employers scramble to fill the resulting gap by offering remedial education programs to employees or hiring foreign IT workers through work visas, the fundamental root of the problem remains.

American schools are not producing enough well-educated, highly skilled students who possess 21st Century Literacy — the ability to read with comprehension, clearly



communicate, solve problems, work in teams, and operate today's technology. Many schools have been working on reforms and have made important improvements. But too many American schools have not kept pace with the demand for skilled, well-educated students who can fill the jobs of today and the future.

Relevance of Raising Student Achievement to Developing the IT Workforce

No single reading, math, or science reform, implemented in isolation, will equip students with the knowledge and skills needed to enter the IT workforce or succeed in other challenging, high demand occupations. Instead, American schools must make large-scale and dramatic improvements in what they teach students and how they teach them.

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Challenges to Raising Student Achievement

Starting at the Beginning: Early reading

It seems basic. And, it is. A child cannot begin "reading to learn" unless he first "learns to read." With almost 40 percent of American children at the end of third grade reading at a level "below basic," far too many students are not prepared to read with comprehension that will allow them to gain additional knowledge and skills.[70]

Reaching Higher Levels of Achievement in Math and Science

Testimony presented to the Commission indicates that employers, as well as postsecondary faculty, are still profoundly concerned that high school graduates cannot perform the mathematical computations required for further study or training in math, science, engineering, and IT-related courses or jobs. Learning advanced math and science builds logical thinking and problem-solving skills requisite for entry into, and success in, postsecondary computer science and engineering programs.

"If we want the world to fulfill its real potential, we have to make all of our children truly prepared. It's not only the right thing to do; it's good business."

- Carly Fiorina, CEO, Hewlett-Packard

Building Technology Literacy for the 21st Century

To gain 21st Century Literacy, students must be adept in using technology as early as elementary school so that they will have the foundation needed to acquire more specific, core technology skills in the later grades. These core technology skills will change over time as new technologies emerge, but today's high school graduates must know how a computer works, how to use word processing, spreadsheet, and financial applications, how to communicate using e-mail, and find and analyze information on the Internet.

The National Educational Technology Standards (NETS) developed by the **International Society for Technology in Education (ISTE)**[71] outline core technology skills and set out a sequence in which these skills should be acquired by students, beginning in the earliest grades. A related effort was developed by the **Techforce Initiative**, a partnership among the **Education Development Center, ITAA** and the **National Alliance of Business.**[72] The Techforce Initiative's "IT Pathway Pipeline Model" offers a framework for building technology skills and

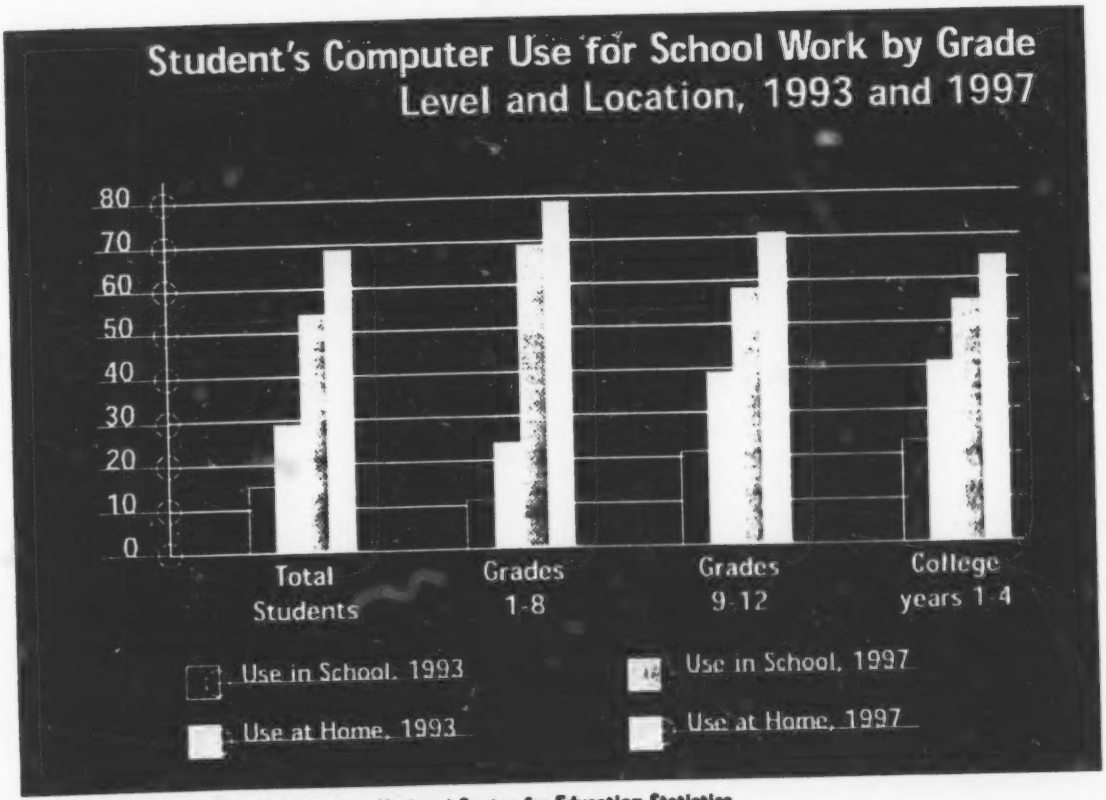
"We are constantly canceling classes in networking, programming, C++ and JAVA. Classes full of students are being canceled because we cannot find teachers, as they are being gobbled up by the industry here. We cannot afford to compete with the salaries currently being offered in the Valley."

- Dr. Leo E. Chavez, Chancellor, Foothill-DeAnza Community College Network, California

integrating technology into learning throughout a student's educational career.[73] These frameworks can be used as a starting point for the development of challenging local standards.

Recruiting and Retaining High-Quality Teachers

On a national level, American schools will need to hire 2.2 million teachers through 2008. About one-half to two-thirds of these teachers will be first time teachers.[74]



Source: U.S. Department of Education, National Center for Education Statistics

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Many school leaders worry that they will not be able to find qualified teachers in sufficient numbers to meet this demand.

- The teacher crisis mirrors the crisis in the IT workforce. In some parts of the country, there are more graduates of teaching colleges than there are open jobs. In other regions, there are dramatic shortages of teachers with the right knowledge base and skill sets needed to prepare students for the world of work and postsecondary education.
- The most intense shortages are for qualified math, science, and engineering teachers. Again and again, the Commission heard complaints from education leaders, at both the high school and postsecondary level, that it is extremely difficult to recruit and retain teachers who have advanced knowledge and skills in math, science, and engineering. The job and pay opportunities in the private sector are too alluring to keep many technically skilled teachers in education.

Teachers Using Technology for Learning

Technology is a powerful tool. But as a tool, technology must be applied for a purpose. It is not enough for teachers to know how to use technology. Teachers must become experts at integrating technology into the curriculum as a learning and research tool. An intensive professional development initiative for current teachers is needed to ensure that they are both technologically literate and know how to use technology effectively in the classroom.

Ensuring that every teacher is technologically literate and able to access information technology and the information resources of the Internet will also help teachers become more effective lifelong learners. They can enroll and participate more easily in distance-learning courses and use the Internet to learn about and stay up-to-date on effective teaching techniques, the subject matter they teach, and promising curricular and management reforms.

Trends and Practices in Raising Student Achievement

Early Reading

Community leaders concerned about meeting tomorrow's workforce needs should insist that community and school-based early reading instruction programs implement practices that are supported by the most authoritative research on reading. The research, most recently summarized by the National Reading Panel,[75] clearly indicates what elements must be in place for a child to become a successful reader. The Commission's *eHandbook of Promising Practices and Resources* details examples from communities, school districts and the states that have already implemented effective reading initiatives based upon these elements.

Reaching Higher Levels of Achievement in Math and Science

- The Texas Pre-freshman Engineering Program (TexPREP) at the University of Texas at San Antonio is an eight-week, summer math enrichment

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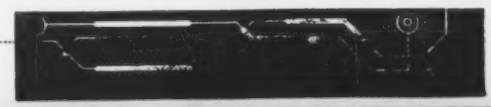

program for middle and high school students interested in science, engineering, and other math-related careers. Other business-led partnerships are meeting with middle school and high school students and encouraging them to enroll in rigorous high school programs that include a full complement of math and science courses.

- The Texas Scholars Program and "Learn to Earn" in Vermont and New York are examples of successful partnerships between business organizations and schools. These partnerships conduct marketing campaigns and promote personal interaction between students and business leaders to deepen student awareness of the opportunities for IT careers. Students learn that IT jobs are "cool," and that they need strong academic skills to pursue careers in the IT industry or other rewarding educational and career opportunities after high school.

"Our success demonstrates that students typically rise to the occasion, learning what they are expected to know. Without encouragement, some young people will simply not take strong academic offerings. With these courses, our graduates will have choices – to be able to go to work, to college, or to vocational school."

- Deborah Cron, Ph.D., Garland Independent School District

Enhancing the Teaching Profession

Schools can address the shortage of skilled math, science, and technology teachers in a variety of ways, including:

- Investing in professional development for current teachers to provide them with the knowledge and skills needed to teach in high-demand subject areas.
- Increasing teacher salaries.
- Offering incentives for teaching in high-demand content areas.
- Creating flexible certification processes to bring qualified, experienced professionals into the classroom.
- Offering teachers and school counselors summer internships and other work experience opportunities with high technology businesses to improve their understanding of the needs and demands of work in IT and other knowledge-based industries.

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- Testing more intensive uses of technology in assisting high-school math and science instruction to determine whether new instructional models can deliver equal or superior learning gains as the more traditional and labor-intensive instructional approaches.
- Exploring creative tax incentives and staffing policies that would allow businesses and schools to share the talents of IT professionals who are qualified to teach or tutor in high-demand subject areas.

Teachers Using Technology for Learning

Multiple initiatives supported by businesses and federal and state governments are beginning to address the need for teachers to integrate technology as a teaching and learning tool. **Intel Corporation,** in partnership with **Microsoft** and **Hewlett Packard,** is launching a three-year project, **Teach to the Future,** that will train

"The scope of this program (Teach to the Future) represents the industry's recognition that all the educational technology in classrooms today is worth nothing if teachers don't know how to use it effectively. Computer's aren't magic, teachers are."

- Craig Barrett, CEO, Intel Corporation

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100,000 U.S. classroom teachers (400,000 teachers worldwide) to effectively integrate computer technology into existing curriculum to improve student learning.[78] Additionally, a program funded through the U.S. Department of Education, **Preparing Tomorrow's Teachers to Use Technology (PT3),** will allocate funds over three years to support training for a total of 600,000 new U.S. teachers to use computer technology as a teaching tool.[79]

Leadership Response to Raising Student Achievement

Reforming K-12 education systems, state-by-state, community-by-community and school-by-school, is the only long-term solution.

The Commission has observed numerous leadership responses to raising student achievement and implementing these reforms. Leaders in the classroom, on the school board, and in the corporate board room, all of whom share a vision of student success, are essential.

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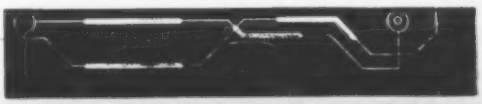

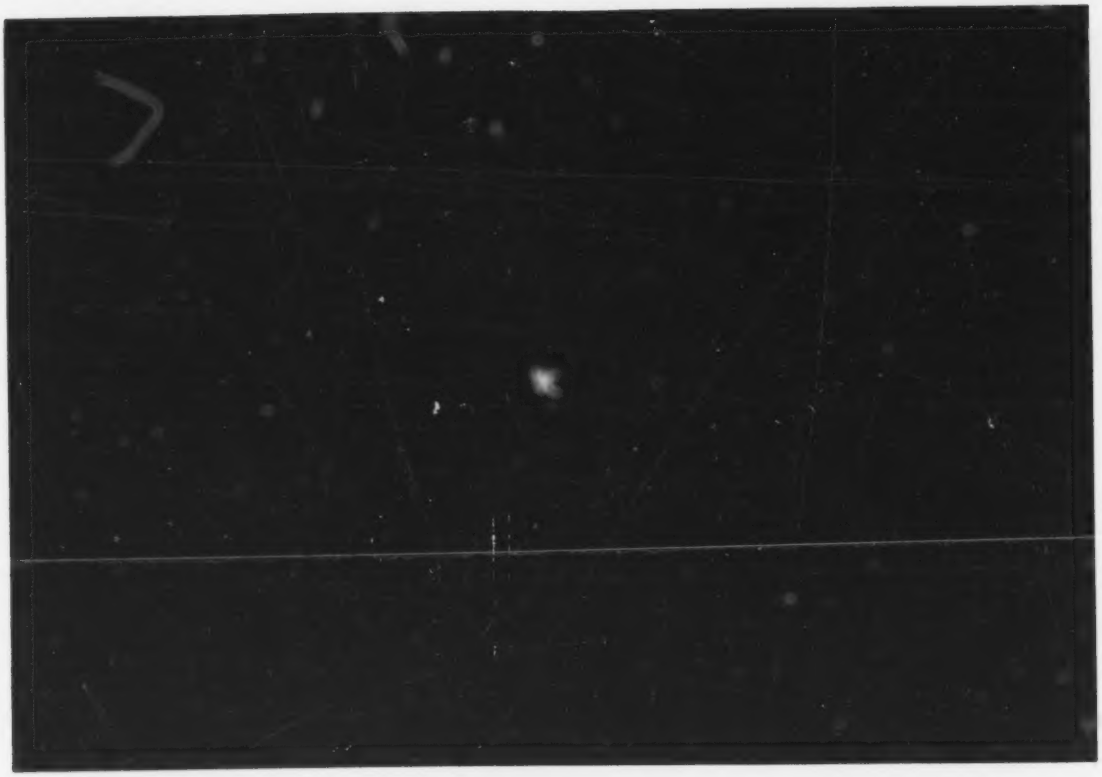

- These are the people who cut red tape, inspire and support teachers, involve parents, and energize students.
- They offer flexibility to people who can design programs that work best in their own communities.
- They set goals and hold people accountable for reaching those goals.
- They work to place skilled and knowledgeable teachers in every classroom.
- They fight arbitrary funding formulas that force schools to spend money unnecessarily.
- They remove artificial barriers that keep secondary schools from partnering with postsecondary schools to get the best teachers and/or establishing dual-credit programs.

—School Reform, Improvement and Accountability: Schools, school districts, and the States should pursue a wide range of reforms to improve student academic achievement, focusing their efforts on aligning curricula, assessments, teacher professional development and management practices with rigorous academic content and student performance standards.

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— Early Reading: Schools, parents, and communities need to adopt strategies that will help all children learn to read as early as possible, read at grade level by the end of third grade, and remain on grade level thereafter.

— Math and Science Performance: Schools, school districts, and the States must set consistently higher expectations in math and science for all students, and take steps necessary to increase math and science achievement for all students, regardless of their gender, family income, race, or ethnicity.

— Technology Standards: Schools, school districts, and the States need to adopt technology standards and aligned curricula that will ensure all students achieve technological literacy appropriate to their grade level.

— Teacher Competency: Schools, school districts, and the States should act immediately to help teachers at all levels — elementary, middle, and high school — achieve the level of content competency in math, science, and technology appropriate for the grade level and courses they teach. Distance learning and other innovative approaches should be utilized to accelerate the achievement of this goal.

— Retention of Teachers: Schools, school districts, the States, and local partnerships need to create flexible, innovative incentives to attract a broader pool of qualified teachers and to make teaching a more rewarding and fulfilling career.

— Shared Staffing Models: State and local leaders should explore incentives for businesses to assign staff to teach and mentor in public schools and community colleges on an adjunct basis.

"Any action plan for the future must address the urgency of putting in place a new generation of educators who can impart the knowledge and skills of the New Millennium's workplace."

- Jeff Collins, MCI Worldcom, Jackson, Mississippi

— Technology as a Learning/Teaching Tool: Schools, school districts, and the States, working in partnership with foundations, business and postsecondary education, need to improve and expand teacher professional development opportunities to enable every teacher to integrate the use of technology in instruction.

— Innovative Instructional Models for K-12 Education: States and school districts, supported by federal research funds, should develop and test new models of integrating live and technology-assisted instruction in math, science and technology.

— Federal Priorities in Education: Federal funding for education should support state and local priorities for school improvement, encourage continuous improvement in student achievement, and support research, development and evaluation of effective educational, professional development, and management practices. ◘

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Regional and national strategies need to provide for universal access to Internet connectivity and high-speed broadband connectivity, computing technology, and facilitate training for technological literacy.

Urban and rural areas with large numbers of workers who do not possess 21st Century Literacy, including technological literacy, will be at an enormous disadvantage in attracting new businesses and encouraging start-ups, especially for those companies whose core business requires the use of information technology applications and processes. Individuals without these skills will be similarly disadvantaged in the labor market. Access to technology, relevant IT training, and the Internet are necessary for both individuals and geographic regions to benefit from the Information Economy.

In particular, expanding high-speed, broadband Internet connectivity to disadvantaged inner city and rural areas, coined "New Markets" by President Clinton, is critical to making them more attractive for economic development. Yet, research has shown, and the Commission has learned from testimony, that various geographic areas and individuals are separated from the Information Economy by a vast "Digital Divide."

Relevance of Making Technology Access and Internet Connectivity Universal to Developing the IT Workforce

Universal connectivity, access to information technology, and relevant IT training will help expand the American pool of potential workers with needed IT skills, open up

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untapped regions of the country as new markets for information technology products, and create new opportunities for IT business start-ups and expansion. In particular, the Commission recognizes that:

- Broadband connectivity allows far-greater functionality for the Internet in the form of audio and video communications. In the near-term, businesses are beginning to use applications (for example, "Apps-on-Tap") that will require high-speed connectivity. As business-to-business transactions become "web-enabled" and e-commerce expands, more businesses, especially those in the high-growth technology areas, will demand high-speed Internet access. It is critical that no region of America or individual be cut off from the benefits of broadband access.
- High-speed connectivity to individual homes will enable more IT workers — such as computer programmers, web-designers, and other IT and technology-

"Getting broadband out there may be the toughest of all the things I've talked about, because that requires building infrastructure, and that requires the right regulatory environment. I do see very rapid growth in those broadband connections, and a lot of the investments we're making are to help people drive that forward as fast as they can."

Bill Gates, Founder and Chairman, Microsoft Corporation

enabled workers — to work from home offices. In addition, new IT workers will be able to be trained in their homes for IT jobs with powerful, web-based learning applications. And, in coming decades, as new web-based applications demanding high-speed access become pervasive across the consumer market as well as the business market, every home will benefit from high-speed connectivity.

Challenges to Making Technology Access and Internet Connectivity Universal

The Digital Divide

The Digital Divide is a term that describes inequity in access to computers and the Internet between various groups of individuals and regions of the country.

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Over the last few years, increasing numbers of Americans have bought computers or gained access to the Internet.

- In 1995, they were only 22 million Internet users in the United States.
- By 1998, the figure had quadrupled to 88 million, and that may grow to 133 million by the end of the year 2000. [80]
- An estimated 64 million Americans go online every month. [81]

Still, among many Americans, especially those who are poor, have low levels of education, or live in rural areas, technology use and connectivity lag far behind that of other Americans. For example:

- African-American and Hispanic households are roughly two-fifths as likely to have home Internet access as white households.[82]
- Between 1997 and 1998, the gap in Internet usage between black and white households increased from a 13.5 percentage point difference to a 18.6 percentage point difference, with all households indicating increased Internet usage.[83]
- At every income level, those in urban areas are more likely to have Internet access than those earning the same income in rural areas.[84]
- Low-income households in rural areas are the least connected, with rates in the single digits for both computer ownership and Internet connectivity.[85]

If this Digital Divide is not bridged, it will broaden the skills gap, as many Americans continue to be cut off from opportunities to learn valuable technology skills in demand in the workplace.

Americans who do not have access to important online resources will fail to keep pace in terms of personal growth and the acquisition of new knowledge and skills.

Conversely, a low-income or underserved individual who gains access to technology, the Internet, and IT training can accelerate his or her acquisition of important technology skills, helping decrease the Digital Divide.

Realistically, as we work to ameliorate the effects of current gaps in technology access and skills, there will never be a "final victory." There will always be new waves of individuals entering the workforce who are not fluent in the use of technology. There will be emerging technologies that place new demands on the existing information infrastructure, and new regions that need to be connected in different ways.

Long-term strategies must anticipate the ongoing need for training in technology and expanding Internet connectivity as new technologies enter the marketplace.

Trends and Practices in Making Technology Access and Internet Connectivity Universal

During its hearings, the Commission learned of various regional initiatives that are helping disadvantaged families gain access to information technology, the Internet, and the training to use the technology productively.

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Innovative partnerships of welfare-to-work programs, community-based organizations, and the IT industry are building community technology centers that bring information technology and Internet access into neighborhoods and homes previously untouched by the Information Economy. These community technology centers are providing IT training, coordinating computer-recycling initiatives, and assisting new Internet users with some of the up-front costs associated with getting connected.

The Commission is pleased that networks are forming among top executives from technology companies to respond to the technology and skills gaps. Spurred on by an assortment of tax incentives over the next decade, the private sector will likely make a sustained effort to provide hardware and software, to establish partnerships with community organizations to expand the availability of technology and connectivity, and to train teachers in the use of technology.

"In telecom speak, analog cellular was the first wave. And digital networks the second. The third generation of data and voice communications — the convergence of mobile phones and the Internet, high-speed wireless data access, intelligent networks, and pervasive computing — will shape how we work, shop, pay bills, flirt, keep appointments, conduct wars, keep up with our children, and write poetry in the next century."

- Steve Silberman, contributing editor, Wired Magazine

In addition, the market is working to bring down costs for computing devices and Internet access. Among the reasons for optimism:

- The cost of computing continues to drop with new business models making good computers and Internet access available for monthly fees around $25.
- New technologies such as web-based software applications ("Apps-on-Tap") could gradually reduce the cost of software usage.
- Companies are selling "Internet appliances" (simple devices that perform only e-mail and Internet browsing) for around $100 plus monthly fees.
- Companies of all sizes are subsidizing the purchase of computers and monthly Internet connections for their workers.
- Wireless technologies are being developed that could reduce costs and accelerate the availability of broadband access through microwave transmissions and the use of space- or aircraft-based satellites to rural and urban areas.

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"To attract businesses in the next century, communities will have to offer access to high-bandwidth transmission systems and a wide array of telecommunications services. By some estimates, traffic on the Internet doubles every 100 days. Yet as many as 12 states may be at serious risk of not achieving the broadband access required to stay competitive in the growing digital economy. To support demand, many states will need to make or encourage dramatic increases in communications investments."

National Governors' Association, "The New Economy"

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Leadership Response to Making Technology Access and Internet Connectivity Universal

In building the infrastructure for broadband connectivity, many witnesses told the Commission that the "market" would drive much of the process. However, there are isolated pockets of rural and urban America for which existing economic conditions do not make the cost of connectivity an attractive investment.

Federal and state tax incentives, regulatory changes, and targeted economic development funding may be necessary to spur investment and deliver broadband connectivity to these isolated areas.

— Partnerships among Public and Community Organizations: Partnerships among public institutions such as libraries, schools, postsecondary institutions, One-Stop Career Center networks, and community and faith-based organizations should provide technology access to underserved individuals and families.

— Training in Technology: These partnerships should ensure that, in addition to the provision of hardware, users also have opportunities to learn how to use software applications and access the Internet.

— On-line Education and Skills Content: Partnerships, supported by public and foundation funding, should develop models to make on-line training content available — at low or no cost — to help individuals gain specific skills that will enable them to enter financially rewarding IT careers that lead to economic self-sufficiency.

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— Availability of Technology: Federal and state governments should allow the creative use of welfare-to-work, Workforce Investment Act, and other funds to extend connectivity to the communities and homes of economically disadvantaged families.

— Federal and State Policy: Federal and state governments need to consider tax and regulatory policies and targeted funding to bring broadband Internet connectivity to rural and urban areas. In order for these policies to be effective, they should be aligned with workforce training initiatives and the development of new business models that take advantage of broadband connectivity. ■

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"We realize we can't just wave that magic technology wand and fix all of rural America's problems. Our rural communities face four major economic challenges – jobs, infrastructure, training, and expectations."

- Dave Sollak, President, ExplorNet

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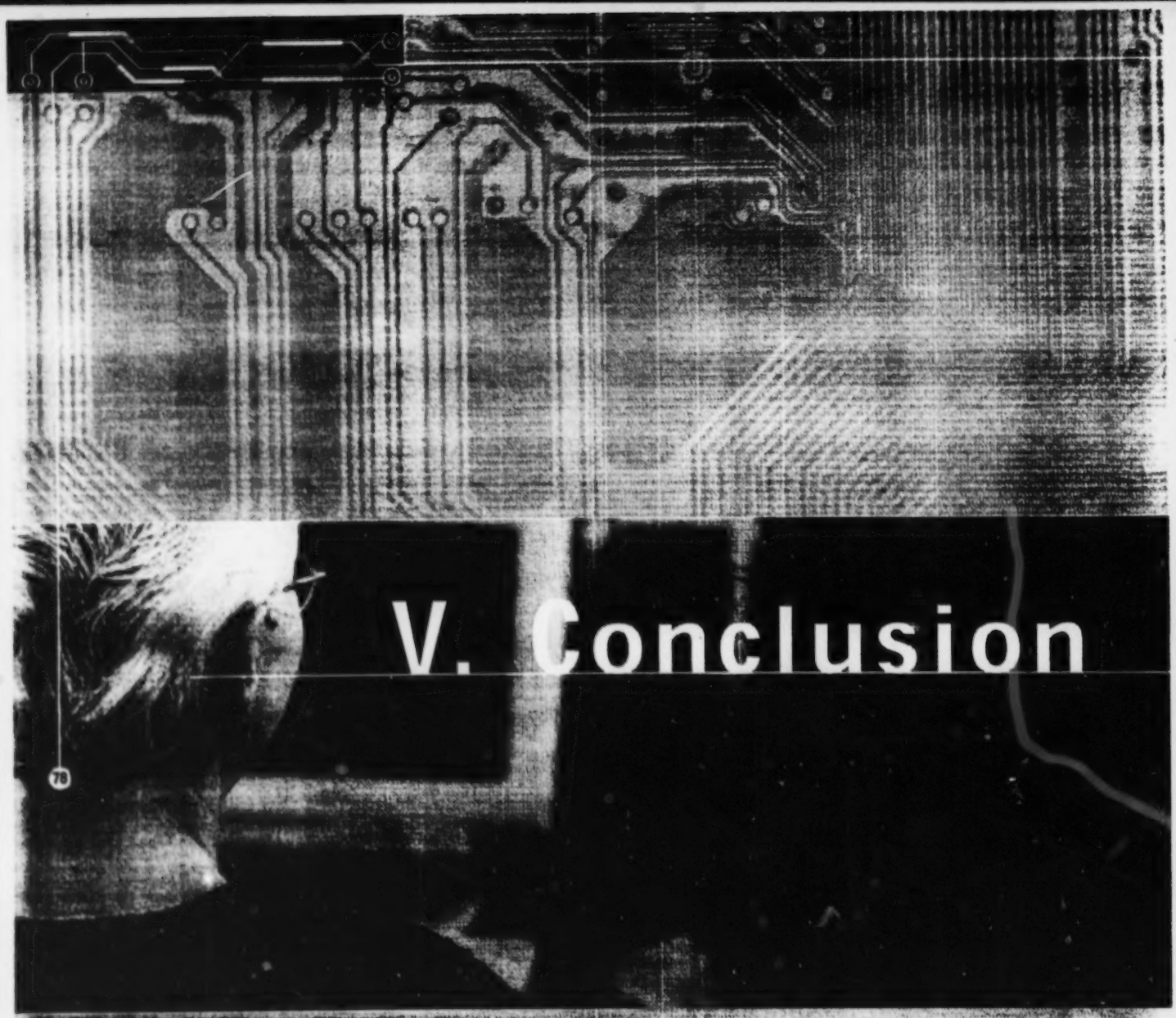
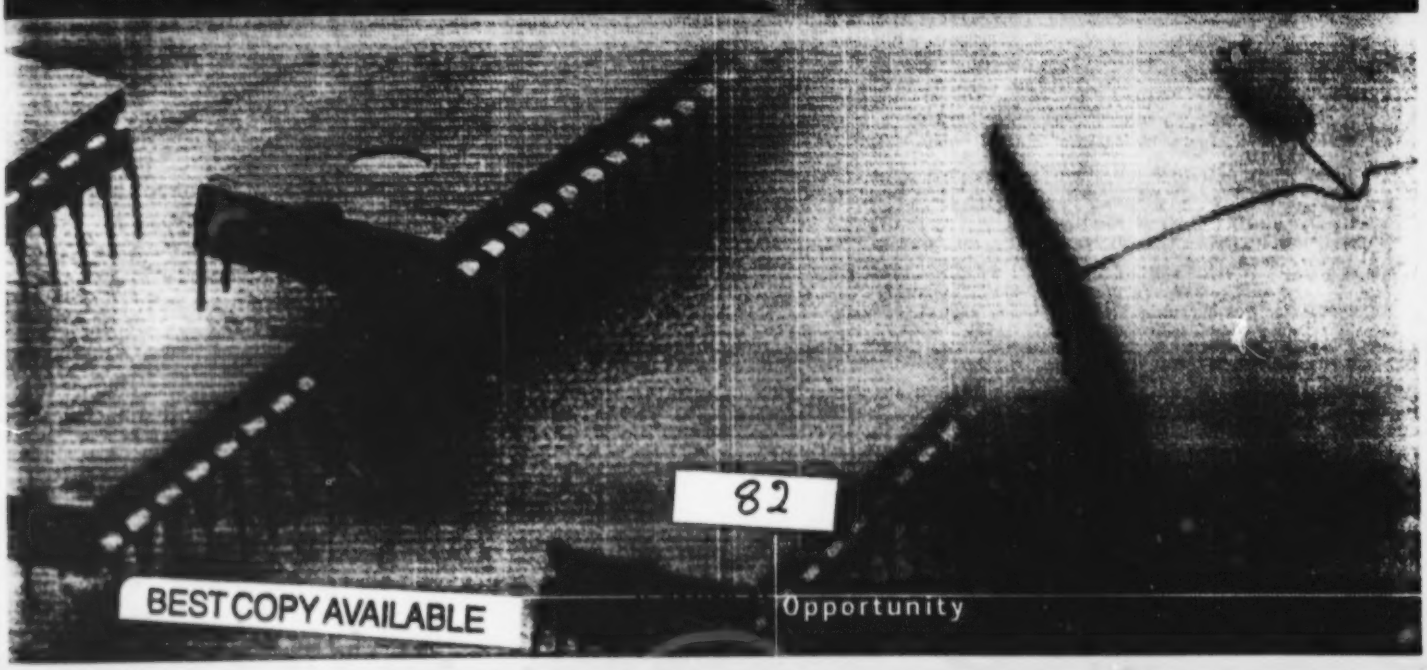


V. Conclusion



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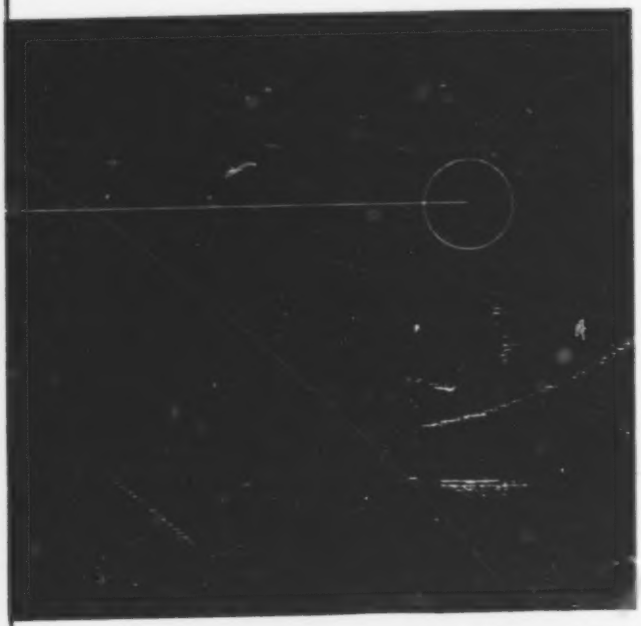
Leadership Through Partnerships: A "Uniquely American" Response

From the start, members of the 21st Century Workforce Commission sensed that the Commission's recommendations must have a "uniquely American" flavor. These recommendations must capture the essence of what makes the American system vibrant and flexible enough to successfully respond to widely varying circumstances and cultural environments.

As the Commission met with educators, business leaders, community activists, and workers around the nation, it saw examples of innovative and creative local solutions. During their tenure, the Commissioners have been reflecting on what links all of these wonderfully diverse solutions and initiatives.



No matter how well aligned and carefully structured policies and programs may be, leadership is the essential spark that ignites the engine of change.

In the preceding sections, the Commission identified nine Keys to Success: a comprehensive array of strategies that are necessary for America to develop a workforce capable of facing the economic challenges of the 21st Century. They are:

- Building 21st Century Literacy
- Exercising Leadership Through Partnerships
- Forming Learning Linkages for Youth
- Identifying Pathways into IT Jobs
- Increasing Acquisition of IT Skills
- Expanding Continuous Learning
- Shaping a Flexible Immigration Policy
- Raising Student Achievement
- Making Technology Access and Internet Connectivity Universal

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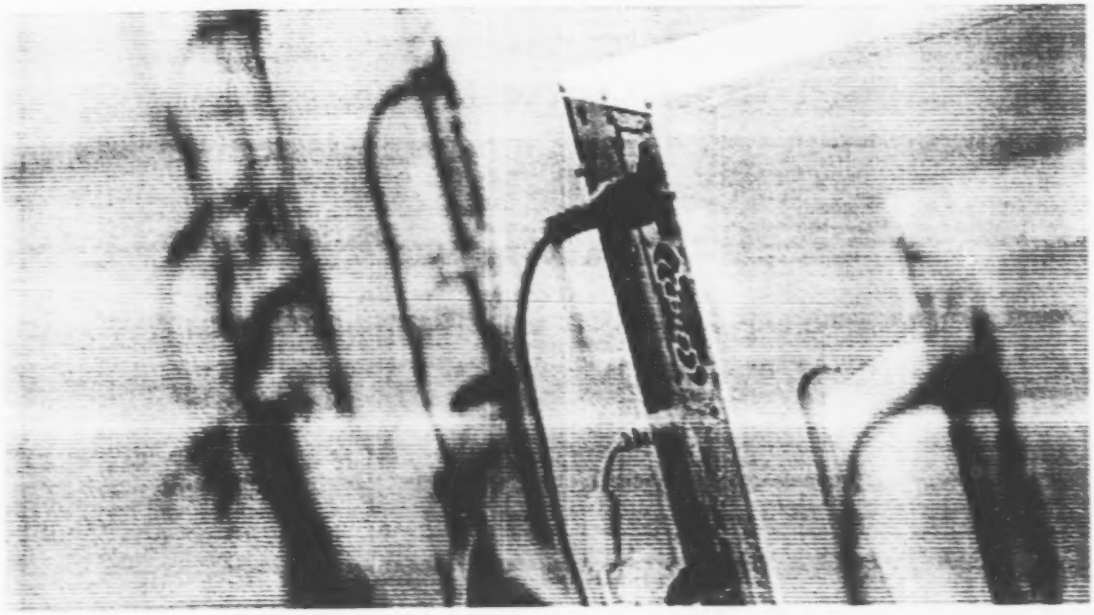
The connecting force is empowered leadership — leaders in the local chambers of commerce, at the community colleges, at the job training programs, and in the school-improvement teams. These leaders are ordinary Americans who step forward and accomplish extraordinary results.

No matter how well aligned and carefully structured policies and programs may be, leadership is the essential spark that ignites the engine of change.

Putting these Keys to Success into practice will require the best that Americans have to offer: Risk-taking, and can-do leadership expressed through collaborative, results-oriented partnerships.

We encourage each of you, whether you are a member of Congress or a member of the local Lions Club, to act as a leader in your community.

Through individual leadership and working in partnership with others, we can ensure that every child, youth, and adult can reach a high level of 21st Century Literacy. We can expand the number of individuals qualified to enter high-skill, high-paying information technology jobs, and buttress America's economic competitiveness well into the 21st Century. ◘



The Commissioners

Lawrence Perlman, Commission Chair
Retired Chairman and Chief Executive Officer
Ceridian Corporation
Minneapolis, Minnesota

Katherine K. Clark, Commission Vice-Chair
Chair, Northern Virginia Technology Council
President and Chief Executive Officer
Landmark Systems Corporation
Reston, Virginia

Susan D. Auld
President
Auld, Bishop & Adams Capitol Strategies, Ltd.
Montpelier, Vermont

Morton Bahr
President
Communications Workers of America, AFL-CIO, CLC
Washington, DC

Patricia Gallup
Chairman and Chief Executive Officer
PC Connection, Inc.
Merrimack, New Hampshire

Dr. Bobby S. Garvin
President
Mississippi Delta Community College
Moorhead, Mississippi

Seth Harris (ex officio)
Counselor to the Secretary
U.S. Department of Labor
Washington, DC

Randel K. Johnson
Vice President, Labor and Employee Benefits
U. S. Chamber of Commerce
Washington, DC

Roger Knutsen
Past-President, National Council for Higher Education
Green River Community College
Auburn, Washington

Patricia W. McNeil (ex officio)
Assistant Secretary
U.S. Department of Education
Washington, DC

Marc H. Morial
Mayor
City of New Orleans, Louisiana

Thomas J. Murrin
Dean, Palumbo and Donahue Business Schools
Duquesne University
Pittsburgh, Pennsylvania

Leo T. Reynolds P.E.
President and Chief Executive Officer
Electronic Systems, Inc.
Sioux Falls, South Dakota

Frank D. Riggs
Alexandria, Virginia

Frank C. Roberts
Mayor
City of Lancaster, California

Kenneth E. Saxe
Senior Consultant
Stambaugh Ness Certified Public Accountants
York, Pennsylvania

David L. Steward
Chairman and Chief Executive Officer
World Wide Technology, Inc.
St. Louis, Missouri

Hans Meeder
Executive Director
21st Century Workforce Commission
Washington, DC

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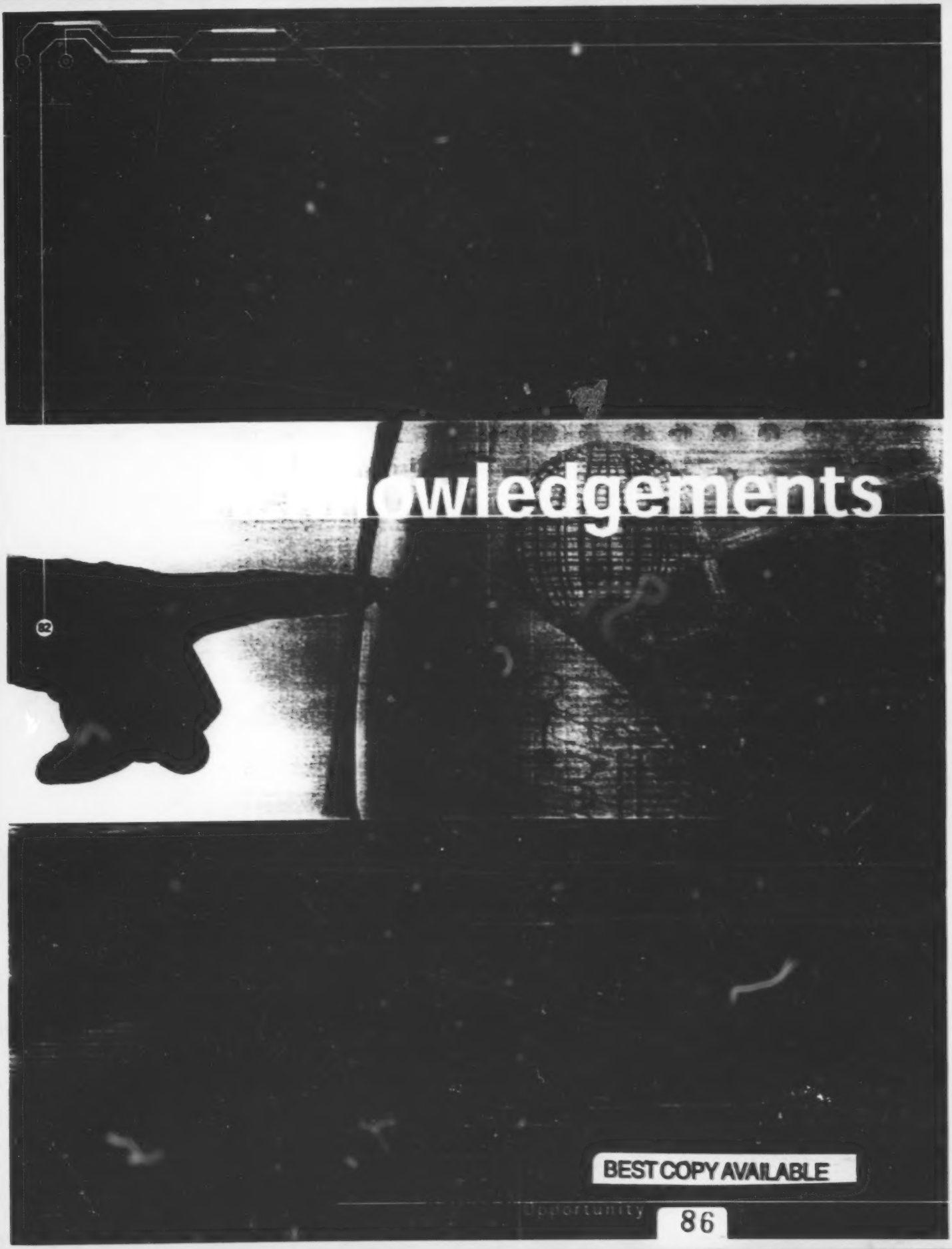

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Hans Meeder, Executive Director of the 21st Century Workforce Commission, took charge of the project from inception to completion. He provided strategic oversight and ably managed logistics. He conducted much of the research and put together hearings, site visits, and town meetings. Drawing on the expertise of the Commissioners, Mr. Meeder led the research and the writing team through the final product.

The 21st Century Workforce Commission also acknowledges the contributions of many individuals and organizations who contributed to the successful completion of this work.

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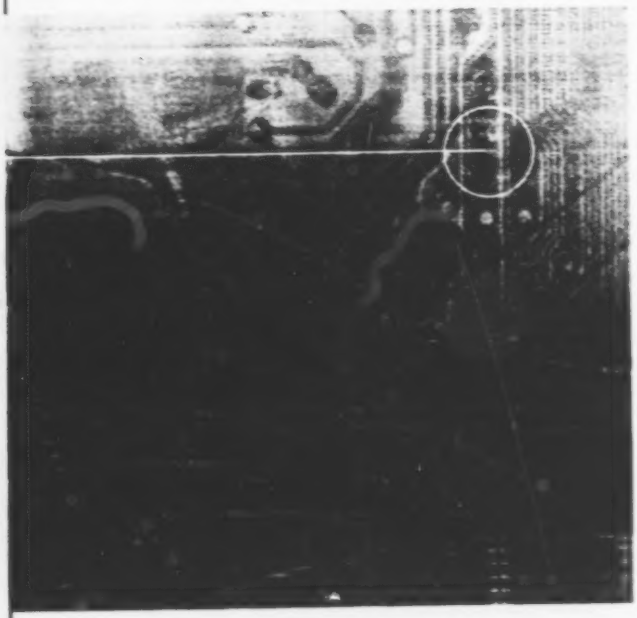

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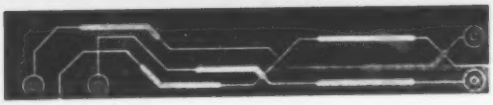

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- Cupertino, California: **Dr. Martha Kanter** and **Jose Nunez,** DeAnza Community College; **Lisa Bruner,** Joint Venture; Silicon Valley Network.
- St. Paul, Minnesota: **Jane Belau** and **Sandra Ledin,** Ceridian Corporation.
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